

ANNUAL REPORT
OF THE
ENTOMOLOGICAL SOCIETY
OF ONTARIO,
FOR THE YEAR 1874.

INCLUDING REPORTS ON SOME OF THE NOXIOUS AND BENEFICIAL
INSECTS OF THE PROVINCE OF ONTARIO.

PREPARED FOR THE HONOURABLE THE COMMISSIONER OF AGRICULTURE,
ON BEHALF OF THE SOCIETY.

BY

THE REV. C. J. S. BETHUNE, M.A.,

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Ontario ;*

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Editor of the Entomologist ;

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Vice-President of the Entomological Society of Ontario.

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REPORT OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO FOR THE
YEAR 1874.

To the Honourable the Commissioner of Agriculture,—

SIR,—I have the honour to submit for your consideration the Report of the Entomological Society of Ontario for the year 1874, embracing a detailed statement of receipts and expenditures during the year, which accounts have been duly audited, also a list of the office-bearers elected for the year 1875.

The annual meeting of the Society was held at the City of Toronto, at the same time as the Exhibition of the Agricultural and Arts Association in accordance with the provisions of the statute, when the various reports were then presented and approved of.

I have also the pleasure of submitting herewith a Report on some of the Noxious, Beneficial and Other Insects of this Province, which has been prepared on behalf of the Society by the Rev. C. J. S. Bethune, M.A., Mr. Wm. Saunders and Mr. E. B. Reed.

THE CANADIAN ENTOMOLOGIST, the organ of the Society is still issued monthly, and has now nearly reached the completion of its sixth volume, the regular issue of our journal for the past six years has enabled us with the help of our esteemed contributors to disseminate a vast amount of practical, as well as scientific knowledge relating to Entomology which has done much towards increasing the interest felt in this branch of Natural History so important to the agriculturist.

In order to illustrate the pages of this Report, we have procured as large a number of new wood cuts and electrotypes as the limited means at our disposal would admit of, we can only regret that it is not more profusely illustrated as we feel sure that such illustrations add greatly to the interest and usefulness of our report.

I have the honour to remain, sir,
Your obedient servant,

J. H. McMECHAN,
Secretary-Treasurer Entomological Society of Ontario.

ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

The fourth annual meeting of the above Society was held (by the kind permission of the Provost) in the library of Trinity College, Toronto, on the 23rd of September, at 3.30, P.M. The report of the Secretary-Treasurer was presented, showing a slight increase of membership and a satisfactory condition of the finances, after which the President read his annual address, which was by request of those present, kindly placed at the disposal of the Printing Committee for publication.

The following Officers were then elected :—

President.—Rev. C. J. S. Bethune, M.A., Port Hope.

Vice-President.—R. V. Rogers, Kingston.

Secretary-Treasurer.—J. H. McMechan, London.

Council.—E. Baynes Reed, W. Saunders, Rev. G. M. Innes, J. M. Denton, London, G. J. Bowles, Montreal.

Editor of Entomologist—W. Saunders.

Editing Committee.—Rev. C. J. S. Bethune, M.A., E. Baynes Reed, J. G. Bowles.

Library Committee.—W. Saunders, E. Baynes Reed, J. H. McMechan.

Auditors.—Chas. Chapman and J. H. Griffiths, London.

FINANCIAL STATEMENT OF THE SECRETARY-TREASURER.

Receipts.

To Balance from previous year.....	\$177 62
“ Government Grant additional for 1873.....	500 00
“ “ “ “ “ 1874.....	750 00
“ Members' fees	137 52
“ Sales cork, pins, labels, &c.....	195 02
	<hr/>
	1760 16

Disbursements.

By CANADIAN ENTOMOLOGIST, printing.....	518 75
“ Pins, cork, &c.....	91 02
“ Engravings	118 10

By Library	\$58 95
" Editor's salary for 1872	100 00
" " " " 1874	100 00
" Secretary's salary for 1873.....	50 00
" " " " 1874.....	50 00
" Expenses, sundry small	120 18
" Rent	80 00
" Expenses of Report	51 00
" Balance, cash in bank	422 16
	<hr/>
	1760 16

We certify the above as a correct statement of accounts for the year ending September 23, 1874, as shown by Treasurer's books and with vouchers for the same.

J. H. GRIFFITHS, }
CHAS. CHAPMAN, } *Auditors.*

REPORT OF THE COUNCIL.

It is gratifying, at the expiration of this the fourth year of the existence of our Society, to be able to report its continued well-being and progress, and to know that its efforts are being more and more recognized as an aid to those agricultural interests which constitute the chief source of the wealth of our Province.

The *Entomologist* is still regularly published, and has now nearly reached the close of its sixth volume. By its regular issue there has been placed before our members much useful and practical information relating to many of the commoner insect pests, with instructions as to the use of the best remedies to check their ravages. Besides this it has formed, and still forms, a valuable medium for the publication of such scientific matter in relation to the life history of our insects, which, while of immediate interest to only a limited number of our readers, is of great importance to those engaged in the study of the science of Entomology. We feel that our journal has done and is still doing a good work in this respect; and it is pleasing to know that our efforts in this direction are warmly appreciated by scientific men in the adjoining Republic and in Europe, as well as in our own country.

As mentioned in the Report of the last Annual Meeting, a cordial invitation was extended by the "American Association for the Advancement of Science," at the meeting held in Portland, in 1873, to the members of our Society to be present at the meeting in 1874, in Hartford. A deputation was appointed by your Council to attend this meeting on behalf of our Society, in reference to which the following report appeared in the September number of the *Entomologist*:—

THE AMERICAN ASSOCIATION.

At the recent gathering of this scientific body in Hartford, Conn., there were brought together an unusual number of Entomologists. This was owing partly, no doubt, to the kind invitation extended by the Association to the American and Canadian Entomological Societies to appoint special meetings of their members to be held at that time and place, with the view of having these important societies fully represented. In response to this invitation, a number of members of the American Entomological Society were present, while our Canadian Entomologists were represented by the worthy President of our Society, Rev. C. J. S. Bethune, M.A., and the Editor of the *Entomologist*. Several evenings were occupied by these "brethren of the net" in interesting and profitable discussions on the habits and peculiarities of various insects, the time passing so pleasantly that the midnight hours were reached ere separation could be effected. After mature deliberation it was resolved to organize under the name of "The Entomological Club of the A. A. S.," and the following constitution was adopted:—

TITLE.

I. The name of the association shall be "The Entomological Club of the American Association for the Advancement of Science."

OBJECTS.

II. The annual re-union of the Entomologists of America, the advancement of entomology, and the consideration of all general questions relating to the science that may from time to time arise.

MEMBERSHIP.

III. All members of the American Association for the Advancement of Science who are interested in entomology, shall *ipso facto* be members of the club.

OFFICERS.

IV. The officers of the club shall be a President, a Vice-President, and a Secretary, to be elected annually by vote of the members.

DUTIES OF THE OFFICERS.

V. The President, or in his absence the Vice-President, shall preside at all meetings; the Secretary shall perform all the usual duties of a recording and corresponding Secretary.

MEETINGS.

VI. A meeting shall be held in each year at the place of meeting appointed by the American Association for the advancement of Science; it shall commence at 2.30 p.m., on the day before the meeting of the American Association for the advancement of Science, and be continued throughout that evening; further meetings may be held as time will permit during the week following.

The following resolutions were also unanimously passed:

Resolved, That the members of the American Entomological Society and the Entomological Society of Ontario, together with all other persons interested in entomological science, be cordially invited to attend and take part in the proceedings.

Resolved, That the Secretary be requested to publish notices of the meeting in such periodicals devoted to natural history, and especially in those devoted to entomology as are published on the continent; and further that the members be requested to bring with them at the annual re-unions specimens for exchange and exhibition, and especially types of species that they may have described during the year.

At a subsequent meeting of the Club, the following officers were elected: President, Dr. John L. Leconte, Philadelphia, Pa.; Vice President, Samuel H. Scudder, Cambridge, Mass.; Secretary, Chas. V. Riley, St. Louis, Mo. We feel sure that under such able direction, the Entomological Club of the A. A. A. S. will prosper, and be the means of stimulating many to increased effort, and thus greatly advance the interests of our favourite study.

As it may interest many to know who were present at these meetings, we furnish the following list: Dr. John L. LeConte, Philadelphia, Pa.; Dr. J. G. Morris, Baltimore, Md.; Prof. S. S. Haldeman, Chickis, Pa.; Dr. H. A. Hagen, Cambridge, Mass.; S. H. Scudder, Cambridge, Mass.; A. R. Grote, Buffalo, N. Y.; Dr. G. M. Levette, Indianapolis, Ind.; C. V. Riley, St. Louis, Mo.; O. S. Westcott, Chicago, Ill.; J. A. Lintner, Albany, N. Y.; H. F. Bassett, Waterbury, Conn.; George Dimmock, Springfield, Mass.; B. Pickman Mann, Cambridge, Mass.; E. P. Austin, Cambridge, Mass.; Dr. R. King, Kalamazoo, Mich.; Chas. P. Dodge, Washington, D. C.; Mr. Patton, Waterbury, Conn.; Rev. C. J. S. Bethune, M.A., Port Hope, Ont.; W. Saunders, London, Ont. During the meetings of the Association several interesting and valuable papers on Entomological subjects were read by Dr. LeConte and Messrs. Scudder, Riley and Grote.

The branches of our Society organized at London, Montreal and Kingston, continue to

thrive, and by their frequent meetings and social intercourse stimulate the members resident in these cities to greater application in the service of entomology. We trust that such of our members as can, will aid the editor of the ENTOMOLOGIST by sending him from time to time, memoranda of their observations, on the habits and life history of our insects with any other notes they may deem of interest to the lovers of our favourite science.

Submitted on behalf of the Council by

J. H. McMECHAN,
Secretary-Treasurer.

ANNUAL MEETING OF THE LONDON BRANCH.

The annual meeting of the London Branch of the Entomological Society of Ontario was held at the residence of Mr. W. Saunders, on the 17th of February.

A goodly number of members were present, and the following officers were elected for 1874: President, A. Puddicombe; Vice-President, H. P. Bock; Secretary-Treasurer, J. G. Geddes; Curator, J. Williams; Auditors, Messrs. C. Chapman and J. Griffiths.

A box of Lepidoptera from Miss Carey, of Amherstburg, was shown by Mr. E. B. Reed, containing some interesting specimens taken in that locality; among others there were fine examples of *Papilio thoas* and *Philampelus satellitia*.

W. Saunders exhibited a box of Coleoptera, embracing a large number of species kindly donated by Theodore L. Mead, Esq., of New York. Also, several boxes of European insects, presented by Francis Walker, Esq., of the British Museum. The Secretary was instructed to tender to Mr. Walker the sincere thanks of the Society for his continued liberality in this matter—the cabinets of the Society and those of the members also having been repeatedly enriched with valuable specimens through his kindness.

ANNUAL MEETING OF THE MONTREAL BRANCH.

The first annual meeting of the Montreal Branch of the Entomological Society of Ontario was held on May 6th, 1874, when the following officers were elected for the ensuing year:

W. Couper, President; G. J. Bowles, Vice-President; F. B. Caulfield, Secretary-Treasurer; G. B. Pearson, Curator; Council—W. Hibbins, sen., C. W. Pearson, P. Knetzing.

The reports of the Council and Secretary-Treasurer were read, and, on motion, adopted. The Branch, although young, is in a prosperous condition, the expenses of the past year having been met, leaving a small balance on hand, and the list of members is gradually increasing. Owing to the lateness of the season but little field work has been done, but some rare captures have been made already. The Branch meets as usual at the residence of the President, No. 67, Bonaventure Street, Montreal, P. Q. All business communications to be addressed to the Secretary-Treasurer, F. B. Caulfield, 254, St. Martin Street, Montreal, P. Q.

FIRST ANNUAL REPORT OF THE COUNCIL OF THE MONTREAL BRANCH OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO.

During the summer of 1873 a fortunate circumstance occurred to which this Branch owes its origin. The following gentlemen, viz., Wm. Couper, F. B. Caulfield, Wm. Hibbins, C. W. Pearson and G. B. Pearson, met by chance on the Montreal Mountain, where the subject was discussed, and it was then decided to hold a meeting at the residence of Mr. Caulfield, in order to make further arrangements for its formation. This meeting was held on the 30th of August, when it was resolved to form a branch in connection with the Entomological Society of Ontario, and the Secretary *pro. tem.* was instructed to write to the parent society, asking permission to form a Branch Society in this city. This proposition was at once accepted by the parent Society.

On the 16th of October the following officers were elected for the ensuing year :—William Couper, President; M. Kollmar, Vice-President; F. B. Caulfield, Secretary-Treasurer; Council—G. J. Bowles, P. Knetzing and C. W. Pearson; Curator, William Hibbins.

By-Laws were framed for the guidance of the Branch, which were approved by the parent Society. Our monthly meetings have been regularly held and well attended, and your Council congratulate the Society on benefits derived. During the eight meetings which have been held, independent of the production of original communications on Entomology, there were remarkably good exhibitions of insects, which also tended to give additional information to members.

The first meeting of the Branch in August, 1873, consisted of seven members, and since then five additional members have been elected.

The following papers were read during the winter months :—

“A Dissertation on Northern Butterflies,” by William Couper; “On the Cicindelidæ Occurring on the Island of Montreal,” by F. B. Caulfield; “On Some of the Benefits Derived from Insects,” by F. B. Caulfield.

The following works have been donated during the year :—

“On Some Remarkable Forms of Animal Life from the Great Deeps of the Norwegian Coast,” by G. O. Sars, 1 Vol.; “On Norwegian Crustaceans,” by G. O. Sars, 2 Vol.; “Synopsis of the Aerididæ of North America,” by Cyrus Thomas, 1 Vol.

Your Council would suggest that the Curator procure store boxes for the preservation of the specimens obtained for the Society during the approaching season. In this way the nucleus of a collection can be formed prior to the purchase of a cabinet, which your Council trusts the Society will be possessed of before next winter.

Your Council would also suggest that members carry note-books wherein to record Entomological observations, especially relative to insects injurious to the crops; also, of such species as are considered beneficial in checking the progress of destructive insects. As this is one of the principal objects of the Society, field notes of this nature are always valuable, and should form subjects of investigation and discussion at our meetings. Attention should be given to the larval forms of insects, as this is a specialty of Entomology from which much knowledge is yet to be obtained.

Your Council strongly impress on the members to use their influence in promoting a knowledge of the importance of the study of Entomology, more especially with Agriculturists and horticulturists, in order to enable them to check the ravages of the numerous insects injurious to vegetation.

All of which is respectfully submitted.

C. W. PEARSON,
GEO. JNO. BOWLES.

Wm. Couper, Chairman.

ANNUAL ADDRESS OF THE PRESIDENT OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO, 1874.

To the Members of the Entomological Society of Ontario :—

GENTLEMEN,—I beg to offer you again, after the lapse of a year, my hearty congratulations upon the continued prosperity of our Society. As you have already learnt from the Report of our Secretary-Treasurer, we have been favoured with a slight increase in our list of membership—as large, indeed, as can fairly be expected in a Society which confines itself to the study of a particular branch of Natural Science, and which cannot therefore attract into its ranks many who are not specially engaged, to some extent at least, in this limited field of investigation.

It is especially pleasing to find that our number of branches continues to increase—a highly successful one, with its headquarters in Montreal, having been organized since our last annual meeting. Its first annual report has been already presented to us in the pages of our journal.

The CANADIAN ENTOMOLOGIST, upon whose success the well-being and fair fame of our Society so largely depends, has—I am sure you will agree with me—been more ably sustained

than ever before. The thanks of the whole Society are assuredly due to the energetic and talented Editor, Mr. Saunders, who has been, indeed, its mainstay from the issue of its first number till now. It would be well if all our members would aid him, not only by contributions, but also by increasing the circulation, and thereby improving the means of support of the publication.

When I applied just now the term "limited" to our field of enquiry, I only did so when considering Entomology as one amongst a large number of sections of the great circle of natural sciences, which includes within its area the study of all things material which come within the range of man's intellectual powers. If we look, however, at Entomology and its objects alone, we cannot fail to see at once that it is practically without limit—that there is work enough for thousands of investigators for almost innumerable generations to come. And when we couple with Entomology other kindred sciences, such as Botany, Geology and Physical Geography, which are so closely allied that no student can safely overlook them, we begin almost to be overwhelmed with the vast extent of this field of knowledge that we seek to explore. So vast, indeed, is the field that no one now ventures to survey the whole of it, except in a very general way; each explorer finds himself compelled—if he would do any effective work—to confine his labour to some one or two of its sections or subsections. By this division of labour, all departments of the Science will by degrees be taken up, and much that is now a '*terra incognita*' will become familiar to the patient explorer.

In our own country—within the bounds of this great Dominion—there is need of many more students and explorers. Even in this Province of Ontario, the headquarters of our Society, where more has been done than in any other part of Canada, there is yet room for a great increase to our band of collectors and investigators. How incomplete, for instance, is even yet our list of Diurnal Lepidoptera, and how many pages are still blank in the life history of some of our commonest butterflies? Our able Editor, my excellent friend, Mr. Saunders, has done much to fill up these blank pages, and his work is everywhere recognized as thorough and authoritative; but yet there remains much more to be done, that we hope our members will before long accomplish. If we turn to Crepuscular and Nocturnal Lepidoptera, we must feel almost appalled at the extent of our ignorance. For those who have the time and the ability, I can think of no more interesting or attractive field of enquiry—none that will sooner or better repay the pains-taking student, whether he looks for fame or pleasure, whether he sighs for fresh fields to conquer, or desires to set his foot where man has not trodden before. In a department where so much remains to be done, we all, I am sure, offer a most cordial welcome to one who has recently cast in his lot among us, and has traversed the broad Atlantic in order to study the Noctuidæ of this country. I allude to Mr. George Norman, of St Catharines, late of Forres, in Scotland.

In another order of insects, the Coleoptera, much, no doubt, has been accomplished. Through the pains-taking labours of a Billings and a Pettit, not to mention other good workers, and by the aid of the great authorities in the neighbouring States, Dr. Leconte and Dr. Horn in particular, we have been able to increase our list of Canadian beetles from a few hundreds at the birth of the Society, to more than as many thousands now. But still how very much more remains to be done? What a field of labour there is before both student and collector in the Carabidæ, the Staphylinidæ, the Curculionidæ and other numerous families of beetles! May we not hope that during the coming winter our present scattered stores of knowledge will be utilized and made available for the good of all, by the compilation and publication of a large addition to our old and valuable list of Canadian Coleoptera?

If there remains so much to be done in these two favourite orders, what shall I say of the remainder, that are so generally neglected? It is surely time that some of our members should devote themselves to the working up of such interesting orders as the Neuroptera, the Hymenoptera, the Orthoptera, the Hemiptera, even if no one can be found at present to take up the study of the more difficult Diptera.

In all these orders there is the nucleus of a collection in the cabinets of our Society, while no doubt much additional material would be furnished by individuals to any member who will take up in earnest the study of any one of them. It would be a great contribution to our knowledge of Canadian insects if there could be published by the Society carefully prepared lists of as many species as possible in each of these orders. Such lists would, of course, be very incomplete at first, but they could easily be so arranged in publication that additions might be made to them at any time, as our stores of knowledge increase.

Such, gentlemen, are some of the modes in which, I think, we should endeavour to extend the operations of our Society. If each year, when we assemble together for our annual meeting, we can point to some such work done in the previous twelvemonth, we shall have good reason to congratulate ourselves upon real permanent progress—upon building up the foundation of an Entomological structure that will prove enduring and substantial in time to come.

Thus far I have referred to Entomology as a purely scientific pursuit; there is another aspect in which we cannot refrain from regarding it, viz., as a subject of very great economic importance to every inhabitant of our land. This view of Entomology has been especially brought before us of late by the havoc that has been produced in our farms and gardens by hordes of destructive insects.

The dreaded Colorado Potato Beetle (*Doryphora decem-lineata*) has spread eastward with great rapidity, and has now reached the Atlantic coast in some parts of the United States. I have been informed by friends who reside in various parts of the Union, that while little, if any, diminution in the numbers of the pest is to be observed in the west, it is becoming very destructive where it has attained to its second year of colonization. During the first year of its invasion of a particular locality, no appreciable damage is done by it, but as its armies increase in geometrical progression, the potato crops of the following season generally suffer to a terrible extent. It has now covered the whole of the Province of Ontario, and is very destructive throughout the western half of it, though we are happy to say that our intelligent farmers and gardeners are effectually using the remedies suggested by our colleagues, Messrs. Saunders and Reed, in their Report to the Legislature a few years ago. In Quebec it is but beginning to be observed; no doubt it will be found there in myriads next year. Across the border, it has penetrated to the western portion of Vermont, into New Jersey, down to the sea coast in Pennsylvania, and in Maryland; at Baltimore, Md., it is very abundant, while straggling outposts have been found as far south as Washington. The whole of New York and Ohio have been pretty well covered with the insect, while in Missouri it is as abundant as ever. In Indiana and Michigan there is a local diminution in the numbers of the pest, but no where are there as yet any signs of its cessation. The people of Europe are now beginning—and with good reason—to feel alarmed at the prospect of its crossing the Atlantic. The English and French scientific and agricultural publications are commencing to publish notices of the insect and to talk of restrictive measures, while in Germany, we are told that stringent regulations will probably soon be put in force by the Government to prevent the invasion of the country. Unless some regulations of this kind are put in general force throughout the whole of Western Europe, I believe that—judging from the spread of noxious European insects on this side of the Atlantic—the Colorado Beetle will soon become there as familiar an object and as destructive a pest as it is here.

While the Colorado Beetle from the Rocky Mountains has been overspreading the whole northern continent eastward, there has been moving southward and westward in a similar manner another insect—the Cabbage Butterfly (*Pieris rapæ*)—that is almost as injurious as the other. This insect, an European importation, as of course you all know, starting from Quebec some few years ago—there first noticed by our friends Messrs. Couper and Bowles has now spread westward over almost the whole of Ontario. At Port Hope it has been this year by far the most common of all butterflies; thousands were to be seen throughout the whole season, from early summer to the present time, flitting about along every road, and hundreds hovering over or alighting in every garden. There is hardly a cabbage or cauliflower fit to be eaten anywhere in the neighbourhood, while stocks and mignonette have been ruthlessly demolished in all the flower gardens. Its spread westward, however, has hardly been as rapid as its movements to the south. The two maritime provinces of New Brunswick and Nova Scotia, and all the New England States, have for some time been occupied, and now I am told that this year it is most plentiful as far south as Washington, and that it is by no means rare in Virginia.

While referring to the wonderful spread of noxious insects during the past few years, and to their excessive prevalence now, I must not omit to mention the affliction caused to our north-west Province of Manitoba and to many of the western States by the swarms of locusts, or grasshoppers as they are termed (*Caloptenus spretus*). The accounts of the sufferings caused by this terrible plague are perfectly appalling, and rival anything that we have read of the ravages of the Eastern locusts. Happily for us they do not seem to extend

much further to the east than the Missouri River, though, occasionally they penetrate to some of the broad prairies beyond. As a detailed account of this insect will probably be afforded you in the forthcoming Annual Report of our Society, I need not detain you with any further remarks upon it.

The only other insect to which I need now call your attention for a moment, is the Grape Vine *Phylloxera*. I am glad to learn that its ravages in the vineyards to the south of us have been comparatively trifling this year, and that in all probability the summer droughts to which we are so liable, will prevent its ever being as formidable a foe as it was at one time apprehended.

To turn from this not very cheerful subject, I may mention, before concluding, that Mr. Saunders and myself duly attended the recent meeting at Hartford, Conn., of the American Association for the Advancement of Science. There we had the pleasure of meeting a large number of Entomologists from all parts of the United States, and we had the further gratification also, of being presided over, in general session, by the ablest of American Entomologists, Dr. Leconte, and in the Zoological Section, by another great worker in our department, Mr. S. H. Scudder. Informal meetings of Entomologists were frequently held, and finally it was agreed upon to form an Entomological Club of members of the A.A.A.S., who should assemble annually a day before the meeting of the Association in the place that may be from time to time selected for its sessions. In this way we trust that much may be done for the furtherance of our favourite branch of science, and that Entomologists generally, from all parts of the continent, will bring together their types of new species and the surplus of their collections for mutual information and benefit.

Without further trespassing upon your time and attention, I beg to thank you, gentlemen, for the kind consideration you have shown to my colleagues and myself during our term of office, and with hearty wishes for the continued prosperity of our Society,

I have the honour to be, gentlemen,

Your obedient servant,

CHARLES J. S. BETHUNE,
President E. S. of O.

Trinity College School,
Port Hope, September 22nd, 1874.

INTRODUCTORY.

ONCE again at the close of another year, a few of the members of the Entomological Society of Ontario have undertaken the task of endeavouring to lay before the public, some information respecting the habits and lives of the insect world, and more especially those members of it which have a direct or indirect influence upon the growth or well-being of the produce of field or forest.

It is a satisfaction to know that these annual reports are read and appreciated, and that many of our practical Fruit-Growers and Agriculturists are desirous of obtaining some knowledge of the transformations of the various and beautiful members of the insect world, of those beautiful atoms of God's creation, each in its appointed sphere fulfilling the purpose for which it was created, drawing forth our wonder, our admiration and our praise ; for "He who wondereth at nothing hath no capabilities of bliss, but he that scrutinizeth trifles hath a store of pleasure to his hand, and happy and wise is the man to whose mind a trifle existeth not."

" He prayeth best who loveth best
All things both great and small,
For the dear God that loveth us,
He made and loveth all."

ENTOMOLOGICAL CONTRIBUTIONS.

BY E. B. REED, LONDON, ONT.

1. THE IO MOTH (*Saturnia Io*).
2. THE FLAT-HEADED APPLE-TREE BORER (*Chrysobothris femorata*).
3. THE LOCUST TREE BORER (*Clytus pictus*).

1. THE IO MOTH *Saturnia (Hyperchiria) Io*. [Fabr].

Order, LEPIDOPTERA ; Family, BOMBYCIDÆ.

This lovely moth is well worthy a place in the cabinet of the collector, and from its brilliant colouring and conspicuous markings is always sure to attract notice and admiration.

The moth belongs to a family which has received the name of "BOMBYCES" from *Bombyx* the ancient name of the silk worm. As, however, it is in the larval or Caterpillar state that this insect more frequently meets our eye, we will begin by a description of it in that stage.

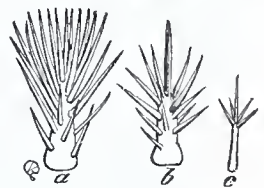
The full grown larva of which, fig. 1 is an admirable representation, is of a most delicate apple or pea-green colour with a broad dusky white stripe at each side bordered with lilac on the lower edge. The body is covered with spreading clusters of green bristles tipped with black. These bristles are exceedingly sharp, and when the insect is handled will produce a very irritating sting similar to but much sharper than that of the nettle, and the effect of which causes a reddening of the flesh and the immediate appearance of raised white blotches which last for a considerable time. Fig. No. 2 shews the appearance of these bristles, some of them as *b*, being stouter and more acute than the others and able to inflict a sharper and more penetrating sting. This stinging property is very curious and is not very easily explained ; Mr. C. V. Riley writing of a very similar insect, the *Saturnia Maia*, says, "that the sting is caused by the prick of the spines, and not by their getting broken in the flesh. From the fact that the spines appear hollow, one would naturally attribute their irritating power to some poisonous fluid which they eject into the puncture. But I have been unable to resolve any apical aperture, nor was Mr. Lintner more successful. Hence I infer that the irritating property belongs to the substance of which the spines are formed, and this opinion is strengthened by the fact that those of a dead larva, or of a cast-off skin which has been in my cabinet for several years, still retain the irritating power, though so brittle that it is not easy to insert them."

In the earlier stages the caterpillars are gregarious, feeding together side by side and in going to and returning from their place of shelter, moving in regular files after the manner of the processionary caterpillars of Europe (*Cneocampa processionea*). This marching habit is so very peculiar that it is well worth describing. Though the insects move without beat of drum they maintain as much regularity in their steps as a file of soldiers. The celebrated naturalist Reaumur, writing of the European Procession Moth says, "I kept some for a little

FIG. 1.



FIG.



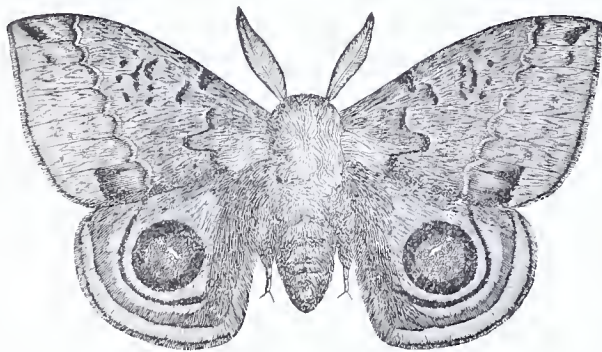
time in my house in the country, I brought an oak branch which was covered with them into my study, where I could much better follow the order and regularity of their march than I could have done in the woods. I was very much amused and pleased at watching them for many days. I hung the branch on which I had brought them against one of my window shutters. When the leaves were dried up, when they had become too hard for the jaws of the caterpillars, they tried to go and seek better food elsewhere. One set himself in motion, a second followed at his tail, a third followed this one, and so on. They began to defile and march up the shutter, but being so near to each other that the head of the second touched the tail of the first. The single file was throughout continuous; it formed a perfect string of caterpillars of about two feet in length, after which the line was doubled. Then two caterpillars marched abreast, but as near the one which preceded them, as those who were marching in single file were to each other. After a few rows of our processionists who were two abreast, came the rows of three abreast; after a few of these came those who were four abreast; then there were those of five, others of six, others of seven and others of eight caterpillars. This troop so well marshalled was led by the first. Did it halt, all the others halted; did it begin again to march, all the others set themselves in motion and followed it with the greatest precision. That which went on in my study goes on every day in the woods where these caterpillars live. When it is near sunset you may see coming out of any of their nests by the opening which is at its top, which would hardly afford space for two to come out abreast, one caterpillar, as soon as it has emerged from the nest, it is followed by many others in single file; when it has got about two feet from the nest, it makes a pause during which those who are still in the nest continue to come out; they fall into their ranks, the battalion is formed; at last the leader sets off marching again, and all the others follow him. That which goes on in this nest passes in all the neighbouring nests; all are evacuated at the same time."

According to "Harris," the caterpillars of the Io Moth do not spin a common web, but when not eating they creep under a leaf where they cluster side by side. When about half grown the caterpillars disperse, each seeking a location for itself. They moult five times, the larvae devouring their cast off spinous skins. After being in the larval state about eight weeks, they arrive at maturity, and are then about two and a half inches long, and present the appearance of Fig. No. 1.

Their food plants are very numerous. They have been found on Black Locust, Indian Corn, Willows, Sassafrass, Wild Cherry, Elm, Hop Vine, Balsam, Balm of Gilead, Dogwood, Choke Cherry, Currant, Cotton and Clover. I this year found two larvae on the English Filbert, and bred them to maturity on that plant. I have, however, more commonly found them on the Choke Cherry. The larvae when full grown ceases eating, and crawls to the ground, where, amongst the loose leaves and rubbish, it forms a rough outer covering, within which it makes a slight cocoon of tough, gummy, brown silk. In this retreat a transformation is soon effected to the pupal or chrysalis state, from which, having remained therein during the winter and spring months, the moth emerges in the perfect winged condition about the month of June.

The moths are remarkable for the difference between the sexes both in size and colour.

Fig. 3.



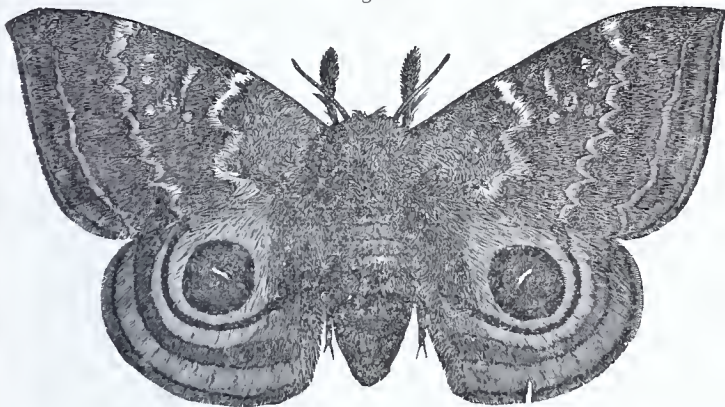
The male (Fig. 3), which is much the smallest, is of a deep Indian or maize yellow colour.

On the forewings are two oblique, wavy lines near the hind margin and a zig-zag line near the base. There is also a large, dark, reddish, central reniform spot or blotch; this is very marked in all the Canadian specimens I have seen, although in the cut, which is drawn by Mr. Riley, probably from a specimen taken in the Western States, the spot is not so distinct. The hind wings are broadly shaded with purple next to the body; near the hinder margin is a curved purplish band, and within this again is a smaller one of a dark purple or violet colour. In the centre of this last band and the middle of the wing is a large round blue spot, with a whitish centre and a broad border, almost black. It is from these prominent eye-spots that the moth derives its name, in allusion to

the classical Grecian fable of the beautiful Io who, having incurred the displeasure of the jealous Juno, was placed by her under the watchful vigilance of the hundred-eyed Argus.

The under side of the wings is of the same deep yellow—the forewings having the inner margin broadly shaded with purple and shewing the reniform eyed spot very distinctly; the hinder wings are more uniform in colour, with a transverse purple line, and a very small distinct white spot representing the centre of the large spot on the upper side. The body is also deep yellow—somewhat darker on the thorax. The antennæ, as usual in the males of the bombyces, are beautifully pectinated, presenting a double comb-like appearance. The male varies slightly in size, from two and a half to two and three-quarter inches in width.

Fig. 4.



The female (Fig. No. 4) is considerably larger, ranging from three to three and a half inches. The specimens vary much in colour, from a dark purplish brown to a warm ochreous red. The fore wings have similar wavy zig-zag lines, the reniform blotch being less distinct than that in the male; the inner margin is of a deeper colour, and with the head and thorax is thickly coated with a short, woolly, pilose covering. The

hind wings are marked in a similar manner to those of the male. The undersides of the wings have the same uniform colour, and are marked much like those of the male.

The body is ochreous yellow, a little lighter above, and each segment is bordered with a narrow, reddish band.

“The moths have a fashion of sitting with their wings closed, and covering the body like a low roof, the front edge of the underwings extending a little beyond that of the upper wings, and curving upwards.”

The eggs are deposited on the under side of the leaf, and are described by Mr. Riley as being compressed on both sides and flattened at the apex, the attached end smallest. Their colour is cream white with a small black spot on the apical end and a larger orange one on the sides. A cluster found on Sassafrass by a western lady contained about thirty eggs. The moths are nocturnal, flying only by night.

THE FLAT-HEADED APPLE-TREE BORER.

Chrysobothris femorata, (Fabr).

Order, COLEOPTERA; Family, BUPRESTIDÆ

Among apple-growers there has been during the past year or two a great complaint of some borer infesting their trees, and investigation has shown that it is to this little beetle that the injuries may be traced.

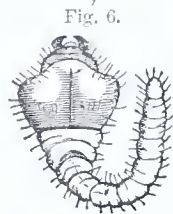
Fig. 5.



Although insignificant in size, yet its larva is capable of doing immense mischief in our orchards. The beetle belongs to a family of insects which is especially remarkable for their rich and varied colouring, many having most brilliant tints. The one we are describing, fig. 5, is of a greenish brassy black colour above, the under side having a bright coppery hue. It is about half an inch in length. It is of an oblong oval shape, blunt round head, and tapering towards the tail. It flies by day and is very swift on the wing. It may often be seen during the summer months running up and down the trunk and limbs of trees or resting itself, basking in the sunshine.

The larva, fig. 6., is a pale yellow, footless grub, its anterior end being enormously enlarged, round and flattened. Dr. Fitch worked up the history of this little pest some years ago. According to his account “the parent beetle deposits its egg on the bark from which a worm hatches and passes through the bark, and during the earlier stages of

its life, consumes the soft sap wood immediately under the bark. But when the worm approaches maturity and has become stronger and more robust, it gnaws into the more solid heart-wood, forming a flattish and not a cylindrical hole such as is formed by most other borers, the burrow which it excavates being twice as broad as it is high, the height measuring the tenth of an inch or slightly over. Within this hole the larva may be almost always found with its tail curled round completely towards the head, in a manner peculiar to the larvæ of beetles belonging to the family *Buprestidae*. It remains in the tree about a year. It is in the latter end of the summer, that the larva penetrates into the hardwood of the tree; its burrow extending upwards from the spot under the bark where it had previously entered. On laying open one of the burrows Dr. Fitch found it more than an inch in length, and all its lower part filled and blocked up with the fine sawdust like castings of the larva. With regard to remedies, Dr. Fitch advises three: "First, coating or impregnating the bark with some substance, repulsive to the insect. Second, destroying the beetle by hand-picking; and Third, destroying the larva by cutting into and extracting it from its burrow."



His advice is so plain and comprehensive than I cannot do better than quote it at length. "As it is during the month of June and forepart of July that the beetle frequents the trees for the purpose of depositing its eggs in the bark, it is probable that whitewashing the trunk and large limbs, or rubbing them over with soft soap early in June, will secure them from molestation from this enemy. And in districts where this borer is known to infest the apple trees the trees should be repeatedly inspected during this part of the year, and any of these beetles, that are found upon them should be captured and destroyed. It is at mid-day of warm sunny days that the search for them will be most successful, as they are then most active, and shew themselves abroad. The larvæ, when young, appear to have the same habit with most other borers, of keeping their burrow clean by throwing their castings out of it through a small orifice in the bark. They can therefore be discovered, probably, by the new, sawdust like powder, which will be found adhering to the outer surface of the bark. In August or September, whilst the worms are yet young, and before they have penetrated the heart-wood, the trees should be carefully examined for these worms. Whenever, from any particles of the sawdust-like powder appearing externally upon the bark, one of these worms is suspected, it will be easy, at least in young trees, where the bark is thin and smooth, to ascertain by puncturing it with a stiff pin, whether there is any hollow cavity beneath, and if one is discovered, the bark should be cut away with a knife until the worm is found and destroyed. After it has penetrated the solid wood, it ceases to eject its castings and consequently, we are then left without any clue by which to discover it. Hence the importance of searching for it seasonably."

The natural food of this insect is believed to be the white oak, but it is found also on many other trees, such as apple, peach and plum, and, according to Mr. C. V. Riley has most seriously affected the soft maples in the valley of the Mississippi. The beetle when caught contracts all its limbs and feigns death.

THE LOCUST-TREE BORER. [*Clytus Pictus*.—FABR.]

Order, COLEOPTERA; Family, CERAMBYCIDÆ.

This active little beetle belongs to the same family as the *Clytus Speciosus*, of Say, whose attacks on the maple tree I described in my report for 1872.

This is a very common insect, and a most fatal obstacle to the cultivation of the locust tree in Ontario.

In 1866, at the meeting of the Entomological Society of Canada, Prof. Croft, of Toronto, drew the attention of the members to the ravages during the past summer, of this beetle, and stated that many of the acacia trees of Toronto and the vicinity, had fallen victims to the larvæ. Since that date the writer has watched with interest the steady westward progress of this destructive pest. Indeed, so rapid has been its spread, that there is hardly a locality in Ontario now, where it has not made its appearance, and we may almost give up any attempt to check its ravages, or to successfully procure the cultivation of the locust tree.

These beetles are so common now that they will be readily recognized without any engraving. They are from three quarters to half an inch in length. Colour, velvet black,

with transverse lemon-yellow bands, of which there are three on the head, four on the thorax and six on the elytra or wing covers, making thirteen in all; the tips of the elytra are also edged with yellow. The third band on the body is very noticeable, as it forms a very distinct representation of the letter W. The thorax is very globular. The antennæ are dark brown. The underside of the body has the outer edges of the segments, bordered with yellow stripes. The legs are rust-red.

"In the month of September," writes Dr. Harris, "these beetles gather on the locust trees, where they may be seen glittering in the sunbeams, with their gorgeous livery of black velvet and gold, coursing up and down the trunks in pursuit of their mates, or to drive away their rivals, and stopping every now and then to salute those they meet with a rapid bowing of the shoulders, accompanied by a creaking sound, indicative of recognition or defiance. Having paired, the female, attended by her partner, creeps over the bark, searching the crevices with her antennæ, and dropping therein her snow-white eggs, in clusters of seven or eight together, and at intervals of five or six minutes, until her whole stock is safely stored. The eggs are soon hatched, and the grubs immediately burrow into the bark, devouring the soft inner substance that suffices for their nourishment till the approach of winter. During winter they remain at rest in a torpid state. In the spring they bore through the sap-wood, more or less deeply into the trunk, the general course of their winding and irregular passages being in an upward direction from the place of their entrance. For a time they cast their chips out of their holes as fast as they are made, but after a while the passage becomes clogged, and the burrow more or less filled with the coarse and fibrous fragments of wood, to get rid of which the grubs are often obliged to open new holes through the bark. The seat of their operations is known by the oozing of the sap, and the dropping of the sawdust from the holes. The bark around the part attacked begins to swell, and in a few years the trunks and limbs will become disfigured and weakened by large porous tumours caused by the efforts of the trees to repair the injuries they have suffered." The habits of this insect seem to have been known for a long time, for we find a description of them made in 1771, by Dr. J. R. Forster, and Dr. Fitch records that Petivera gave a figure and description of it in his "*Gazophylacium*," published in London in 1702.

The beetle is, undoubtedly, a native species, it never having been found in any other country. In remarking on their destructive powers, Dr. Fitch states, "that one of the principal thoroughfares leading east from the city of Utica was formerly planted on its south side with locust trees, these had become so large and ornamental as to render this one of the most admired avenues in the suburbs of that city. When some thirty (now 40), years since, these trees were invaded by this insect, to such an extent, that in the course of two or three seasons, they were totally ruined, many of them being killed outright, and the remainder having their limbs and branches so lopped off, that they could never recover from the deformity." Michaux also reported that fifty years ago this insect had become so destructive, that many people in different parts of the States were discouraged from planting the locust.

In my own experience, three or four seasons have completely killed the largest trees, and about half that time for many of those of smaller size. The numbers and fecundity of the beetle are very great. I well remember in the early fall of 1873, on passing a small clump of locusts growing in St. Paul's Churchyard, London, Ont., my attention being arrested by the breaking off of a branch of considerable size from one of these trees, and my curiosity being excited, I made an examination, and found that the branch had been eaten almost through by the larvæ, and on looking up at the trunk of the tree, I counted over fifty beetles running up and down; that tree was completely killed that season. I had occasion to pass these trees going up and down to my office, and I am satisfied I must have killed fully one hundred that year, merely treading on them as I found them on the sidewalk beneath, or in the neighbourhood of these trees.

These beetles may often be found feeding on the pollen of the Golden Rod (*Solidago*). Dr. Fitch suggests, "as a feasible plan of checking the multiplication and destructiveness of these borers, to plant a small patch of the Golden Rod where locust trees are grown, that the beetles when they issue from the tree may resort to the flowers as is their habit. They can readily be found thereon, and captured and destroyed. It will be a pastime to the children of the household, whose sharp eyes qualify them well for this employment, to search their flowers."

The gathering should be begun as soon as the beetles begin to appear, and should be

continued for several successive seasons ; if none of the Golden Rod can be conveniently grown, numbers of the beetles may still be caught while pairing on the trunk of the trees ; if too high to reach, a sharp rap against the tree will cause them to drop to the ground. when with a little activity they can be secured.

The grub remains in the tree about a year ; the beetle when handled, makes a peculiar sharp creaking noise.

NOTES OF THE PAST SEASON.

BY W. SAUNDERS.

THE CURRANT WORM (*Nematus ventricosus*, KLUG).

This troublesome pest has been in most localities as abundant as ever during the past summer. Whatever checks nature may have provided to prevent its excessive increase, they seem, as yet, to avail but little, for the larvæ continue to swarm in hundreds and thousands on currant and gooseberry bushes throughout the summer, demanding constant vigilance and liberal supplies of hellebore if the foliage is to be preserved.

For the benefit of those who may not possess copies of our previous reports we have introduced again figures of this insect with such additional notes on this species in its various stages as we have been able to gather during the summer.

FIG. 7.



Fig. 7 shows the eggs as they are laid on the under side of the leaves. These eggs (described from specimens found on the 28th June) are when first laid about $\frac{3\frac{1}{2}}{100}$ ths of an inch long, nearly cylindrical, rounded at the ends, white, glossy and semi-transparent. Eggs found on the same bushes, the same day, but probably laid some days before, measured $\frac{4\frac{1}{2}}{100}$ ths of an inch in length with a corresponding increase in diameter. From this it is reasonable to infer that the eggs increase in size before hatching, the elastic membrane which forms their covering expanding with the development of the enclosed larvæ. The eggs, of which we have examined large numbers, we have never found embedded in the substance of the leaf (as some have stated they are) to any perceptible extent; careful examination under a powerful microscope has failed to reveal any abrasion of the surface after the egg has been forcibly removed.

FIG. 8.

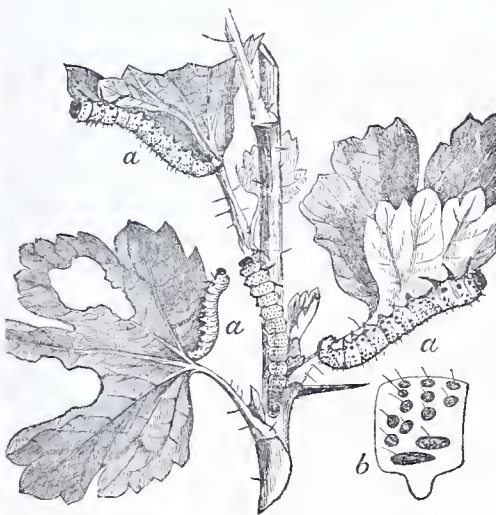


Fig. 8 represents the larvæ nearly full grown, and Fig. 9 the perfect insects, the smaller one being the male, the larger one the female.

On the 19th of June, on going into the garden about 7 A.M., we noticed these perfect insects flying about in scores in sunny spots, around and under gooseberry bushes; in about an hour afterwards when visiting the same spot for the purpose of capturing some, only one here and there could be found, and these had settled on the bushes. A male and female were captured and enclosed in a gauze bag, which was tied so as to enclose a small branch of a gooseberry bush, with several leaves on it, all quite free from eggs. When examined in the evening of the same day, the female was seen laying her eggs; the next morning, on opening the bag, it was found that 48 eggs had been deposited during the interval, the female being still very active. On the

24th of June, this branch was examined again, when quite a number of the young larvæ were found just hatched from the eggs which had then only been laid between four and five days; many of the eggs, however, were found dried up, for which no cause could be discovered.

FIG. 9.

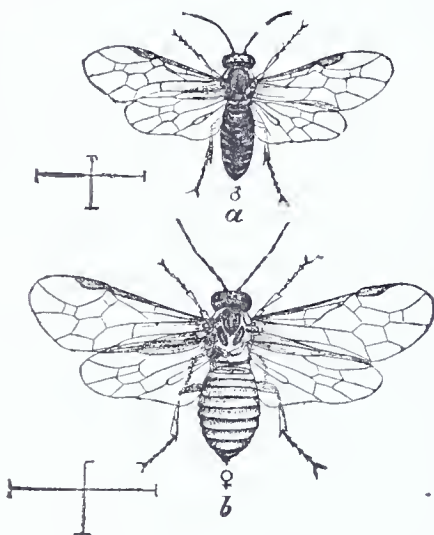


FIG. 10.

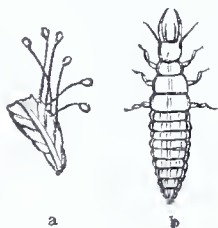


FIG. 11.



On the 30th of June, the larvæ of a lace wing fly *Chrysopa* was observed sucking the juices from the young larvæ of *N. ventricosus*. This friendly helper was a little more than a quarter of an inch long, and had placed itself in the midst of a colony of the young currant worms and had already consumed several before it was taken in the act, Fig. 10 *b* represents one of their larvæ about half-grown, the fly is shown in Fig. 11. The female lace wing fly lays her eggs on long slender stalks, fig. 10 *a*, placing quite a group of them together; they are very pretty objects. It is supposed that these long stalks serve the purpose of keeping the unhatched eggs at a safe distance from the young larvæ first hatched who would, otherwise, probably eat them up. The perfect insect deposits these eggs quite rapidly. On the 18th of June, when out collecting with some friends, one of them captured a lace

wing fly and shut it up in a small box. In a few moments after, having occasion to look at it, he found one egg deposited; after walking a few yards with it to show it to us, which could not have occupied him more than three or four minutes, the box was opened again when it was found that three more eggs had been deposited, we had no opportunity of watching the further deposition or maturing of these eggs. The lace wing fly larvæ are very voracious, and if sufficiently numerous would prove formidable foes to the currant worm.

From about the 12th of May to the end of the season, the currant worms were very abundant. The earlier broods seem to confine their operations almost entirely to the gooseberry bushes, but after two or three weeks they attack the currant bushes with equal vigour. On the 16th of June, we noted the fact that the full grown larvæ in great numbers, others half grown or more and young colonies of the newly hatched larvæ were all to be found at that date on the same bushes. About the last of July, many colonies of these newly hatched larvæ were found almost entirely destroyed by some undiscovered foe; probably some beneficial insect. Many leaves were found with the rows of empty egg shells on them and with a few holes eaten in them, but with the greater part of their substance uninjured, and with but little or no injury to the leaves surrounding; here evidently the greater portion of the larvæ had been destroyed soon after hatching.

On the 10th of July, while emptying out a number of the perfect flies from a box, searching for the empty pupa case of an ichneumon fly found dead in the box, two pupæ of *ventricosus* were found. They were very pretty objects, about one quarter of an inch long, of a very pale and delicate whitish green colour, becoming yellowish green at each extremity; remarkably transparent and delicate looking. The eyes were black and prominent; the feet, antennæ and mouth parts all separately cased, with the same glossy transparent covering almost crystal-like. The wing cases were similar in appearance, but of a little deeper green, bent under and reaching to the first abdominal segment. The pupa seems to be incapable of movement, a slight quivering only of the limbs could be detected under the microscope when pressed on. The feet all terminated in rounded knobs with no visible claws.

THE CURRANT MEASURING WORM *Ellopiæ (Abraxis), ribearia*, FITCH.

This insect has also been very abundant during the past summer. As early as the third week in May, the young larvæ were found quite common on red currant, gooseberry and black currant, and by the first of June many of them had grown to an inch in length; judg-

ing from the numbers infesting the bushes, they appeared to prefer the black currant to either the red or the gooseberry. By the 15th of the month they were well grown, and ap-

Fig. 12.

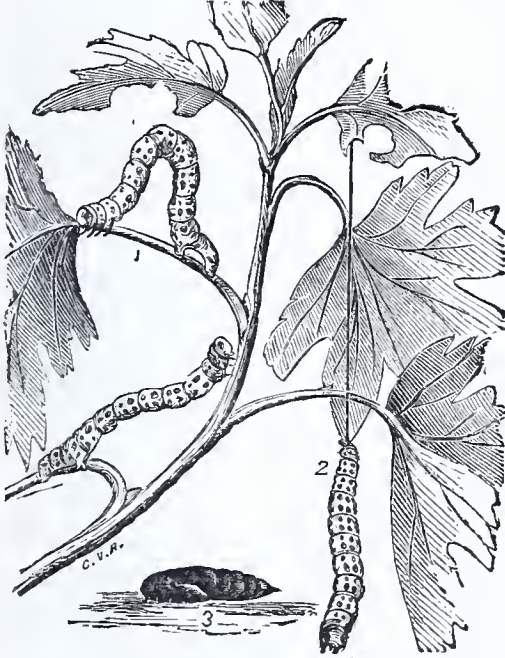


Fig. 13.



peared as shown in fig. 12, (after Riley). They are then nearly an inch and a quarter long, of a whitish colour with a number of black spots on each ring or segment; a wide yellow stripe down the back, and another of the same character along each side, the latter somewhat broken. The underside is white with a slight tinge of pink, also spotted with black, and with a wide yellow stripe down the middle.

The length of the chrysalis see fig. 12, is about half an inch; it is of a dark reddish brown colour, paler between the segments, appearing under a magnifying glass roughened with minute punctures and irregularities of surface; the abdominal segments are dotted with round punctures of varying sizes, while the terminal one is armed with two short sharp brown spines. By the 2nd or 3rd of July, fresh specimens of the moth fig. 13, were on the wing becoming much more abundant about the 6th, when they were observed flying in almost every direction about the bushes. The moth when its wings are expanded measures an inch or more across; the wings are of a pale yellowish colour with several dusky spots, varying in size and form, and more distinct in some specimens than in others; sometimes these spots are so arranged as to form one or two irregular bands across the wings. About the middle of July, some of these active specimens were captured, and one of the females, confined in a box by itself, laid a large number of eggs, 140 in all, between the 22nd and 23rd of July. These were laid loose in the box excepting 24 of them which were slightly attached to the sides. The egg when viewed through a microscope is a very beautiful object; its length is nearly $\frac{3}{100}$ ths of an inch, width nearly $\frac{2}{100}$ ths; in form it is an elongated oval, rather blunt at each end. Colour dull yellowish grey, sometimes with a bluish tinge with the surface honeycombed with regular depressions, the ridges bordering each cell having several bright minute whitish dots, which give the egg a very pretty and brilliant appearance when brought under the strong light of the condenser of the microscope. At the present date, December 1st, these eggs are still unchanged, excepting slightly in colour, owing to the developing larvæ showing through the semi-transparent shell in spots, the larvæ in all probability will not emerge until early spring. As there is only one brood of this insect with us during the year, it is never likely to prove very troublesome; a seasonable application of hellebore will in any case keep it within bounds.

THE WHITE-MARKED TUSsock CATERPILLAR, *Orgyia leucostigma*.

The *orgyia* caterpillar is always common in our section of Ontario. The clusters of eggs from which the larvæ are produced are quite numerous in winter on our fruit trees especially those of the apple, pear and plum, they are securely fastened to the tree along with a dead leaf or two by threads of silk.

Fig. 14.

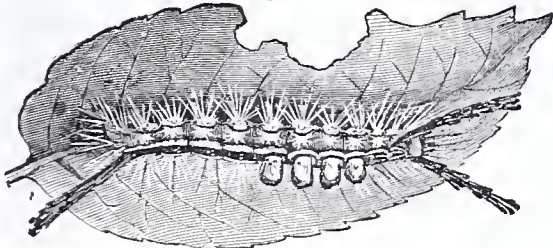
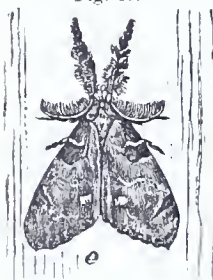


Fig. 14, (after Riley), represents the full-grown caterpillar which, when about to change to a chrysalis, selects a leaf on which to undergo this important transformation, and this leaf in such a position that while the chrysalis is firmly attached to it on the one side, it is firmly secured by silken threads to the under side of a branch on the other, thus securing the leaf from falling to the ground in the Au-

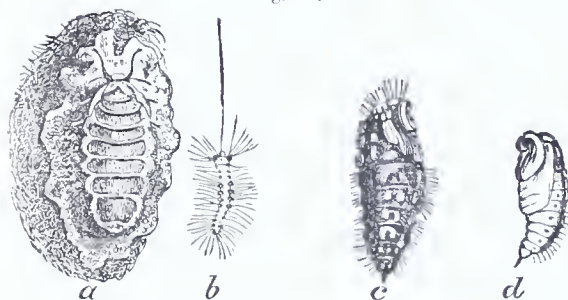
turn. In about a fortnight after the change to chrysalis takes place, the moths begin to make their appearance. The male which comes forth from a chrysalis not more than about half the size of that which produces the female, (*d* fig. 16 shows the chrysalis of the male, *c* that of the female), is a very pretty winged moth, see fig. 15, (after Riley). Its antennae are beautifully feathered or pectinate, and its wings are dark brown, with a white spot on each front wing near the inner hind angle.

Fig. 15.



When at rest its outline is heart-shaped, and its long front feet heavily clothed with hairs and scales are thrust forward to their full length. Very different indeed in appearance is his mate; the female is wingless or furnished with but the merest rudiments of wings which no one would observe without the closest inspection, she is represented at fig 16 resting on the cocoon from which she rarely moves more than a few inches. There she waits the attendance of the male after which the process of egg depositing begins. Dr. Fitch says that the eggs are ex-

Fig. 16.



Colours Yellow and Black.

truded in a continuous string which is folded and matted together so as to form an irregular mass which is glued to the top of the cocoon; on removing this mass of eggs from its place of attachment, the surface of the cocoon appears covered with fragments of a transparent gelatinous-looking substance, which has evidently been applied in a fluid state. The bottom layer of eggs will usually number one hundred or more, and their interstices are well filled with this same gelatinous material, which adheres so strongly to the eggs that

when the nest is torn open, they cannot be separated without bringing away portions of this substance firmly attached. Another irregular layer of eggs is placed on this, then a third, and sometimes a fourth before the total number is exhausted, and through the whole of these the gelatinous matter is so placed as to secure every egg, not by its being imbedded in a solid mass, but surrounded by the material worked into a spongy or frothy state. Over all is a heavy layer of the same, with a nearly smooth greyish white surface, the whole number of eggs being so placed as to present a convex surface to the weather which effectually prevents the lodgment of any water on it.

Within this enclosure from 375 to 500 eggs are securely placed. We have counted the contents of several and 375 is the lowest and 500 the highest number we have found. The egg is nearly globular, flattened at the upper side, not perceptibly hollowed, with a dark point on the centre of the flattened portion surrounded by a dusky halo. Its surface is smooth under a magnifying power of 45 diameters, but when submitted to a higher power, appears lightly punctured with minute dots. Its colour is uniformly white to the unaided vision, but the microscope reveals a ring of dusky yellow surrounding it immediately below the flattened portion. Its diameter is $\frac{1}{25}$ of an inch.

A careless observer seeing a dead leaf here and there upon his trees might readily conceive that they were blown into the position they occupied by accident and retained there by threads of spiders' webs or something of that sort, but a closer examination will furnish food for thought, in the wise arrangements made by the parent moth, in providing for the safety of her future offspring, and at the same time may well excite alarm in the mind of the fruit grower when he perceives promise of the approaching birth of such a horde of hungry caterpillars as even one of these egg masses will produce.

Early in June these eggs begin to hatch and continue to hatch on different trees for several weeks. During the past season we found the larvæ about half an inch long on the 3rd of July, and by the 22nd, some specimens were nearly full grown. There must, however, have been earlier larvæ than these which escaped notice, for on the 29th of July we found a freshly hatched cluster of young larvæ belonging to the second brood. The cocoon had been made and the eggs laid between two young green leaves of a pear tree, the following description was taken the day after.

Length one eighth of an inch. Head, reddish brown slightly bilobed, dotted with black on the sides. Body above, yellowish green, semi-transparent, dotted and spotted with dark

brown. Each segment or ring is provided with a transverse row of tubercles from which arise clusters of long spreading hairs, one pair of tubercles on the sides of the second segment much larger than any of the others and with a larger cluster of hairs; in each cluster there is one or more hairs, very long, longer in some instances than the entire body of the larva, there is a dark brown broken stripe along each side. Hairs mixed, brown and whitish. Changes take place in its appearance at each successive moult until finally it presents the appearance given in fig. 14, and is in adornment one of the most beautiful caterpillars we know of with its vermillion red head and collar, the graceful pencils of long black hairs at each extremity, and the cream coloured brushes or tufts along its back.

Nine different parasites have been found infesting this larvæ. These friendly helpers must do much towards keeping this destructive creature within reasonable limits. Of 34 cocoons lately taken at random from different trees, only ten were found with eggs attached and quite a large proportion of the remainder were infested with parasites. Hence when collecting these cocoons in winter none should be taken or destroyed, but those which have egg masses on them, as all the others will contain either useful parasites or else the empty, harmless male chrysalis. As the female never travels beyond her cocoon, it is clear that this insect can only spread by the wanderings of the caterpillar or the careless introduction of eggs on young trees, no doubt the latter has been the most prolific source of evil.

THE APPLE-TREE BLIGHT.

This strange disease, affecting the tips of the branches of apple and quince trees, has been very common during the past summer, and has extended over a large portion of the western part of Ontario. The first specimens we received this year were from Mr. James Dougall, of Windsor. He writes, on the 27th of June, as follows—"I send you to day, by express, some twigs and shoots of apple and quince trees, affected by what I presume is the twig borer. I have never been able to discover any insects or larvæ in the shoots, but possibly I may have been late in looking for them. The year before last this pest was very bad down the lake shore, about Ruthven, the orchards were browned with it. Last year it attacked my larger apple trees badly, and in the nursery rows some Alexander trees, which were five years old, suffered, while the younger ones were not touched; this year it is worse than last. My quinces have been badly injured for the past three years."

On the same day we received another package from C. F. Treffry, of Hawtry, Ontario, with the following note—"I herewith enclose for your inspection some small branches from some of my apple trees. In passing through my orchard I was surprised to find three of my finest young trees affected as enclosed. I have watched closely for the insect which must have caused such damage, but without success; neither can I find anything in the Society's Report for 1873 which will give me any information respecting it."

This same disease affected the trees very much on the grounds of Mr. Charles Arnold, of Paris, and many orchards in that section of country were similarly injured. In our own location we observed it in one instance only, affecting a few fruit-bearing twigs on a quince tree. About Hamilton, and between that city and Dundas, we saw, in July, many trees which had been badly injured, and, on returning from New York, a few weeks later saw evidences of the same trouble in some of the apple orchards in the western portion of that state. Thus it will be seen that this disease has affected many trees in widely distant portions of our country, and probably has extended much further than we are at present aware of. We shall be glad to hear from our fruit-growing friends in reference to this matter.

The advent of this disease is shown by a sudden withering of the twigs and extremities of the branches, particularly the fruit bearing portions, and embracing the whole of the new growth. Soon the leaves appear as if scorched, and the wood of the affected portions becomes black. Here the trouble seems to end, and later in the season the tree partially recovers its vigour and throws out new shoots from below the base of the affected portion. The fact of the fruit branches being principally involved tells heavily on the crop for the year, and makes this disease a much more serious matter than it would otherwise be. The effects produced are so similar in appearance to the damage done, in some instances by the twig borers that we do not wonder at the prevailing opinion that the injury is in some way caused by insects. The most careful examination, however, fails to reveal the slightest evidence of insect work, and, like the mysterious pear tree blight, its origin and progress are at present involved in

obscurity. From the fact of its affecting only the new and tender growth we should infer that some atmospheric agency is probably concerned in the production and propagation of this disease. At present we have no remedy to suggest.

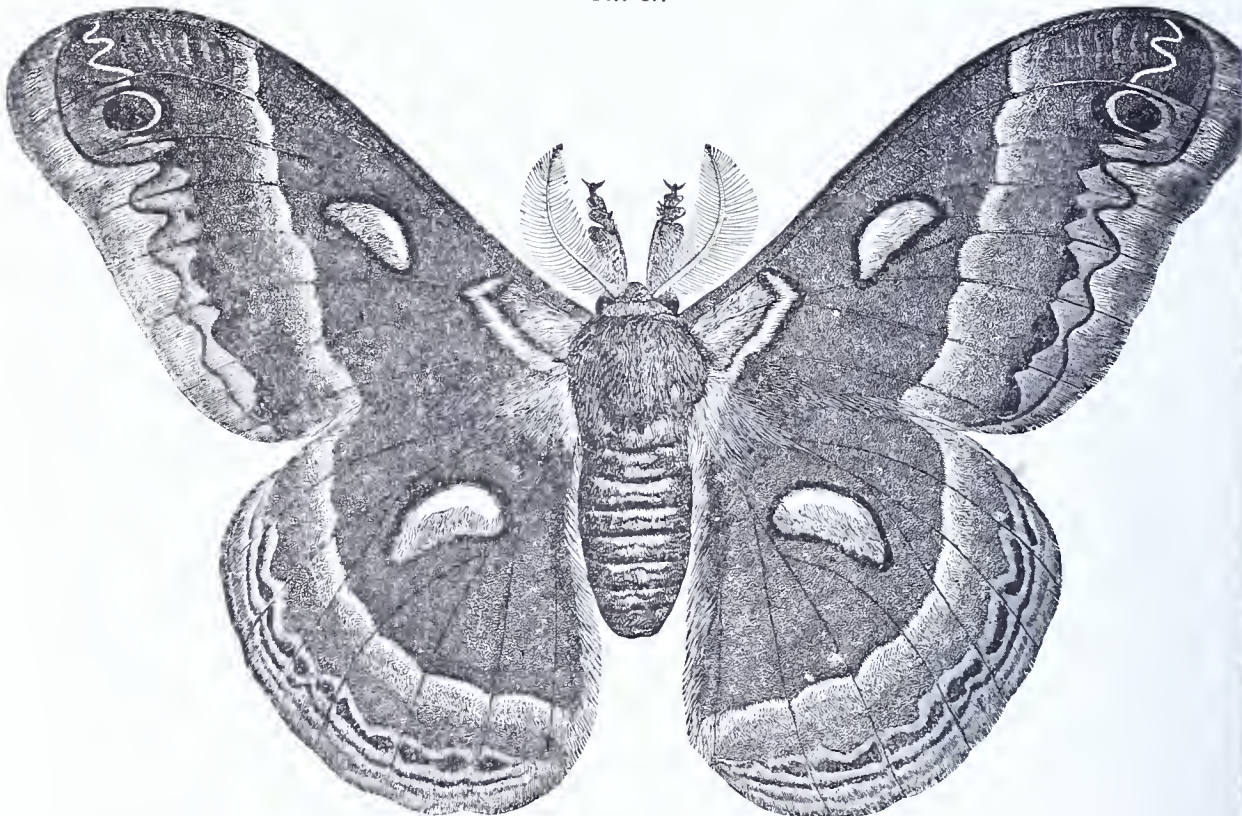
ON SOME OF OUR COMMON INSECTS.

BY W. SAUNDERS.

THE CECROPIA MOTH (*Attacus Cecropia*, LINN.)

Among the many beautiful and wonderful insects native to this country, there is none which excites yearly more wonder and astonishment than the cecropia moth. Its size is enormous, measuring when its wings are spread from five and a half to six and a half inches across, and sometimes even more while its beauty is proportionate to its size. The accompanying figure 17 (after Riley) is a faithful representation of this magnificent creature. Both front and hind wings are of a rich brown, the anterior pair greyish, shaded with red,

FIG. 17.



the posterior more uniformly brown; near the middle of each of the wings there is a nearly kidney shaped white spot shaded more or less with red, and margined with black. A wavy dull red band crosses each of the wings, edged inside on the front wings more or less faintly with white, while on the hind pair the band is widely and clearly margined with the same color. The outer edges of the wings are of a pale silky brown in which on the anterior pair runs an irregular dull black line, which on the hind wings is replaced by a narrow, double broken band of the same hue. The front wings next to the shoulders are dull red, with a curved white and black band, varying much in distinctness in different specimens, and near their tips, there is an eyelike black spot with a bluish white crescent. The upper side of the

body and the legs are dull red, with a wide band behind the head and the hinder edges of the segments of the abdomen white; the under side of the body is also irregularly marked with white. The under surface of the wings is very much like the upper, but somewhat paler.

Cecropia was the ancient name of the City of Athens, and it has been a matter of surprise to some that Linnaeus should have given this name to our moth, Dr. Fitch throws light on this subject in the following words, "The great legislator of this department of human knowledge, as he is expressively styled by Latreille, it has been frequently remarked, was endowed with a genius which, but few of his disciples have inherited, for selecting names for natural objects, which are most appropriate and happy. The idea which was present in the mind of Linnaeus when he named this splendid moth, we think is sufficiently evident. The Athenians were the most polished and refined people of antiquity. The moths are the most delicate and elegant of insects; they were the Athenians of their race. Cecrops was the founder, the head of the Athenian people. When the names of men were bestowed upon cities, ships, or other objects regarded as being of the feminine gender, classical usage changed these names to the feminine form. The moths (*Phalæna*) being feminine, and the name of Cecrops being more euphonious in this form, probably induced Linnaeus to change it in the manner he did. The name thus implies this to be the leader, the head of the most elegant tribe of insects, or in other words the first of all insect kind. What name more appropriate can be invented for this sumptuous moth." The figure we have given is that of a male which differs from the female in having a smaller abdomen and larger and more deeply feathered antennæ or feelers.

During the winter months, when the apple trees are leafless the large cocoons of this moth may be found here and there, firmly bound to the twigs, they are also frequently found

FIG. 18.



on currant bushes, and occasionally also on lilac, cherry, hazel, plum, blackberry, maple, willow and some other shrubs and trees; for this insect in its larval stage is a very general feeder. The cocoon, see fig. 18, (after Riley) is about three inches long, pod shaped and of a dirty brown colour, and is entirely constructed of silk, the fibres of which are very much stronger than those of the common silk worm *Bombyx mori*. The silk has been worked to a limited extent and manufactured into socks and other articles, which have been found very durable; but a drawback to the advancement of this branch of industry lies in the fact that the caterpillars do not bear confinement well, and hence are not easily reared.

The exterior structure of the cocoon is very close and papery-like, but on cutting through this, we find the interior—surrounding the dark brown chrysalis—made up of loose fibres of strong yellow silk. This snug enclosure effectually protects the insect in its dormant state from the extremes of weather during the long wintry months. When the time approaches for the escape of the moth, which is about the beginning of June, the internal dark brown chrysalis is ruptured by the struggles of the occupant, and the newly born moth begins to work its way out of the cocoon. As it is possessed of no cutting instrument of any kind, this would indeed be a hopeless task had not the all-wise Creator made a special provision for this purpose, and to this end a fluid adapted for softening the fibres is furnished just at this juncture and secreted from about the mouth. On listening to the creature as it works its way through, you hear a scraping, tearing sound, which is made by the insect working with the claws on its fore-feet, tearing away the softened fibres and packing them on each side to make a channel for its escape. The place of exit is the smaller end of the cocoon, which is more loosely made than any other part and through which, after the internal obstacles are overcome, the passage is effected without much further trouble.

We have frequently watched their escape. First through the opening is thrust the anterior pair of bushy looking legs, the

sharp claws of which fasten on the outside structure ; then with an effort the head is drawn forward, suddenly displaying the beautiful feather-like antennæ ; next, the thorax, on which is borne the other two pairs of legs, is liberated, and finally, the escape is completed by the withdrawal of the abdomen, through the orifice thus made. Queer looking creatures they are when they first put in an appearance, with their large, fat, juicy bodies, and tiny wings. When the wings are fully expanded they measure from five to six inches or more across, but when fresh from the chrysalis they are but very little larger than the wings of a bumble bee. The first necessity now for the welfare of the individual is to find a suitable location where the wings may be held in a good position for expanding, for without such favourable circumstance they would never attain a serviceable size. It is necessary that a position should be secured where the wings may hang down as they are expanding, for which purpose the under side of a twig is often selected ; and here, securely suspended by the claws, the wings undergo in a short time the most marvellous growth it is possible to imagine. The whole process, from the time of the escape of the moth to its full maturity, seldom occupies more than from half an hour to an hour, and during this time the wings grow from the diminutive size already mentioned to their full measure and capacity.

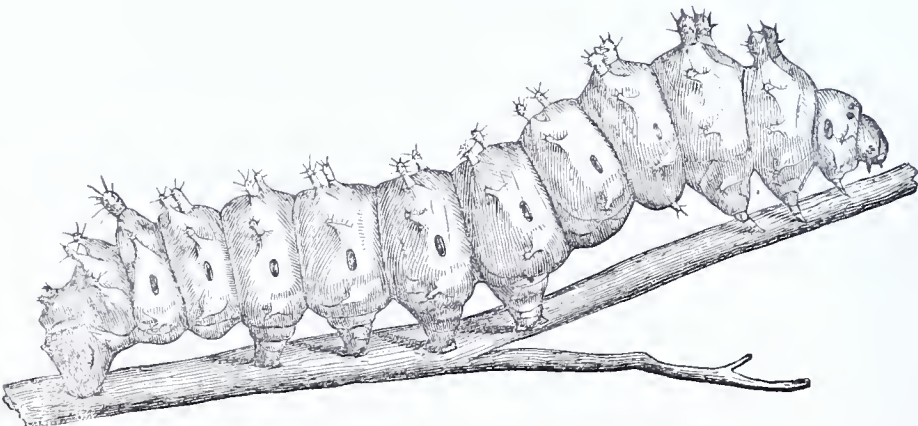
A wing clipped from the insect immediately after its escape, and examined under the microscope, reveals the fact that the thousands and tens of thousands of scales with which the wings are covered, and which afterwards assume such beautiful feather-like forms, are now nearly all threadlike and undeveloped. Impressed with this thought, the mind is fairly astonished at the almost incredible change wrought in so limited a time, for the growth embraces not only the extension of the surface of the wing, but the enlargement and maturity of every scale or feather on it, the individuals of which are but as dust to the naked eye. What a wonderful and intricate system of circulation and power of nutrition must be possessed to accomplish this marvellous result !

Soon after their exit these moths seek their mates, and after pairing, the female begins to deposit her eggs, a process which occupies some time, for the eggs are not laid in patches or groups, but singly ; and are firmly fastened with a glutinous material to the under side of a leaf ; and as it is seldom there are more than one or two laid on any single tree or bush, a considerable distance must be traversed by the parent in the transaction of this all important business.

The number of eggs which these moths lay is astonishing, we have known a single female to deposit within three days as many as 217. The eggs are about one-tenth of an inch long, nearly round and of a dull creamy white colour, with a reddish spot or streak near the centre, the duration of the egg stage is usually from about a week to ten days.

At the expiration of this period the larva eats its way out of the egg, the empty shell of which furnishes the young creature with its first meal. On its first appearance it is black, with little shining black knobs on its body, from which arise hairs of the same colour. Being furnished with a ravenous appetite its growth is very rapid ; and from time to time its exterior coat or skin becomes too tight for its comfort, when it is ruptured and thrown off. At each of these changes or moultings, the caterpillar appears in an altered garb, gradually becoming more like the full grown larva represented by Fig. 19. It is very handsome. Its body is pale

FIG. 19.



green, the large warts or tubercles on the top of the third and fourth segments are coral red, the remainder are yellow excepting those on the second and terminal segments, which, in common with the smaller tubercles along the sides, are blue. During its growth from the diminutive creature as it escapes from the egg to the monstrous-looking full grown specimen, it consumes an immense amount of vegetable food; and especially as it approaches maturity is this voracious appetite apparent. Where one or two have been placed on a young apple tree, they will often strip it entirely bare before they have done with it, and thus prevent the proper ripening of the wood entailing damage to the tree, and, sometimes, endangering its life; hence, during their season, they should be watched for and destroyed. During the winter months, their cocoons may be looked for, and removed in time to check their further spread.

The natural increase of this insect being so great, wise provisions have been made to keep it within bounds. Being such a conspicuous object it sometimes forms a dainty meal for the larger birds; there are also enemies which attack the egg and young larvæ and besides these there are several parasites which live within the body of the caterpillar and destroy it before reaching maturity. One of the largest of these parasites is the long tailed Ophion (*Ophion macrurum*, Linn.) Fig. 20 (after Riley). This is a large yellowish brown Ichneumon

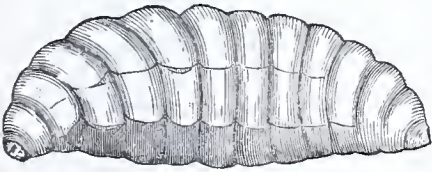
Fig. 20.



fly, and is perhaps one of the commonest parasites affecting the Cecropia. The female of this fly deposits, according to Mr. Trouvelot, from eight to ten eggs upon the skin of her victim. These eggs soon hatch into young larvæ which eat their way through the skin of the caterpillar, and at once begin to feed upon the fatty parts within. As only one of these parasitic larvæ can find food sufficient to mature, the rest either die from hunger or are devoured by the strongest survivor.

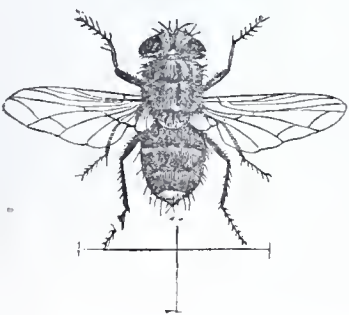
Mr. Riley, in *Am. Ent.* Vol. II., says, "After the Cecropia Worm has formed its cocoon, the parasitic larva which had hitherto fed on the fatty portions of its victim, now attacks the vital parts, and when nothing but the empty skin of the worm is left, spins its own cocoon, which is oblong oval, dark brown inclining to bronze, and spun so closely and compactly, that the inner layers when separated have the appearance of gold beater's skin. If we cut open one of these cocoons soon after it is completed, we shall find inside a large, fat, legless grub, Fig. 21, which sometimes undergoes its transformations and issues as a fly in the fall, but more generally waits until the following spring.

Fig. 21.



"The Ichneumon Fly, last mentioned, usually causes a dwarfed appearance of the worm which it infests, and parasitized cocoons can generally be distinguished from healthy ones by their smaller size. The larvæ of the Tachina Fly which we now introduce to our readers, as parasitic on the Cecropia Worm, seem to produce an exactly opposite effect, namely, an undue and unnatural growth of their victim. In the beginning of September, 1866, we received an enormous Cecropia Worm. It measured over four inches, was a full inch in diameter, and weighed nearly two ounces, but like many other large specimens which we have since seen, it was covered with small oval, opaque, white egg-shells, clusters of four or five occurring on the back of each segment, invariably deposited in a traverse direction. The skin of the worm was black, where the young parasites had hatched and penetrated. The large worm soon died and rotted, and in about twelve days a host of maggots gnawed their way through the putrid skin. These maggots averaged about one-half inch in length, and in form were like those of the common Blow-fly. The head was attenuated and retractile and furnished with two minute curved hooks, and the last segment was squarely cut off, slightly concave and with the usual two spiracles or breathing holes which this class of larvæ have at their tails. Their colour was of a translucent yellow, and they went into the ground and

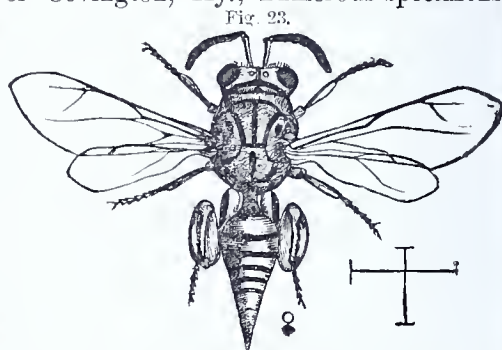
Fig. 22.



of a translucent yellow, and they went into the ground and

remained in the larva state all winter, contracted to pupæ in the April following, and the flies commenced to issue the last of May." This fly differs so little from the red tailed Tachina Fly (*Ecorista militaris*, Walsh), see Fig. 22, which infests the army worm that Mr. Riley is inclined to regard it as a variety of that species.

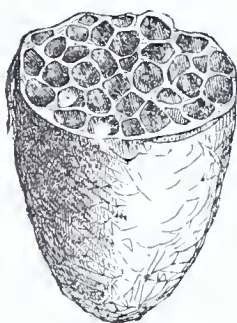
The Cecropia chalcis fly (*Chalcis Maria* Riley). We quote again from Mr. Riley.—"In May, 1869, we received from Mr. V. T. Chambers, of Covington, Ky., numerous specimens of the beautiful large chalcis fly figured herewith (Fig. 23), which he had taken from the cocoon of the Polyphemus moth, which is quite common and issues as early as the middle of February in that locality. He says, 'I was satisfied that the cocoon did not contain a living Polyphemus, and therefore opened it. It contained so little besides these insects and their exuviae as to suggest strongly the old idea that the caterpillar had been metamorphosed into them (as in a sense it had). There were 47 of them, of which 23 were females. As all the males and some of the females were dead when I opened the cocoon, I think it likely that the former never do emerge, and perhaps but few of the latter; otherwise Polyphemus would soon be exterminated.'



Colours Black and Yellow.

"We can very well imagine that most of these chalcis flies would die in their efforts to escape from the tough cocoon of the Polyphemus, but it so happens that these same insects have been found by Mrs. Mary Treat, of Vineland, New Jersey, to prey upon the cecropia worm, from the cocoon of which they can much more easily escape.

Fig. 24.



"The Divorced Cryptus (*Cryptus nuncius*, SAY,—*extrematis*, CRESSON), another Ichneumon fly, infests the cecropia worm in great numbers, filling its cocoon so full of their own thin parchment-like cocoons that a transverse section (Fig. 24) bears considerable resemblance to a honeycomb. The flies issue in June, and the sexes differ sufficiently to have given rise to two species. We have bred seven females and twenty-nine males from a cocoon of the cecropia moth, all the males agreeing with the species described by Say as *nuncius*, and all the females agreeing with that described afterwards as *extrematis* by Mr. Cresson.

THE CLOUDED SULPHUR BUTTERFLY (*Colias Philodice*, GODT).

The clouDED sulphur is everywhere one of our commonest butterflies, abundant in its

Fig. 25.

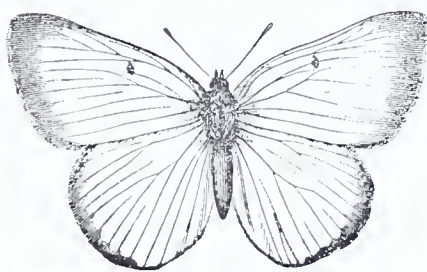
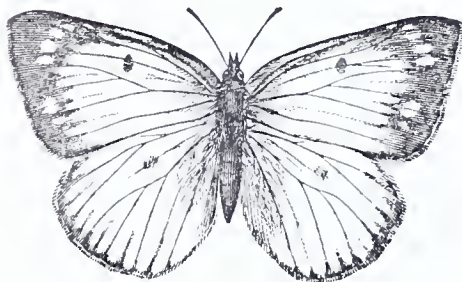


Fig. 26.



Colours Yellow and Black.

season, in fields and roadways, frequently congregating in groups on the borders of streams and springs, where, in hot weather, they seem to enjoy settling on the cool, moist ground. They are still more abundant in clover fields as the season advances.

The female of this species differs somewhat in its markings from the male, as will be readily seen by reference to the figures, 25 representing the male, 26 the female. The ground colour of the wings in both sexes is bright yellow marked on the outer edge with a dark brown or blackish border, narrower in the male than it is in the female, while in the latter it encloses on the anterior wings a broken row of irregular yellow spots, there is also a spot of black placed near the front edge of the forewings, about half-way between the base and tip, varying in form and distinctness. The hindwings in both sexes are less heavily margined, and near the middle is a dull, pale orange spot. Both wings are dusky towards the base, and the fringes are pink.

On the under surface the yellow colour is less

bright, while the dark margins are either entirely wanting or else represented by a dusky shade margined occasionally within by a few dull brownish dots. The spot on the forewings is distinct, but paler and usually centered with a small silvery eye. That on the hind wings is much more distinct than above, being composed of a bright silvery spot in the centre defined by a dark brown line which is in turn encircled with dull orange. Immediately above and a little towards the outer edge is a much smaller spot of the same character; there is also a reddish dot on the anterior edge, about the middle of the wing. The antennæ are pink, with the knobs at their tips of a darker shade; the body is dark above; paler at the sides and underneath.

The insect appears first on the wing about the middle of May, becoming more plentiful towards the latter end of the month, but the time of its greatest abundance is later in the season, after the appearance of the second brood, which is during the latter part of July and throughout August. In the second volume of the "Entomologist," p. 8, Mr. Bethune remarks as follows: "On the 3rd of August, a lovely, bright, warm morning, after an excessively wet night, I drove about ten miles along country roads; every few yards there was a patch of mud, the effects of the heavy rain, and at every patch of mud there were from half a dozen to twenty specimens of *Colias philodice*, at least one, I should think for every yard of distance I travelled. I must then have seen, at a very moderate computation, about ten thousand specimens of this butterfly."

The caterpillar of the Clouded Sulphur feeds on the cultivated pea, on clover, on the Blue Lupin, *Lupinus perennis*, and no doubt on many other plants belonging to the order *Leguminosæ*. The egg, which is a beautiful object, is about one twenty-third of an inch in length, tapering at each end, with twelve or fourteen raised longitudinal ribs, with smaller cross lines in the concave spaces between them. Its colour when first deposited is of a pale lemon yellow, which changes in three or four days to a pale red, then gradually to a bright red, and from that to dark brown just before the time of hatching. The duration of the egg stage is about seven days.

The young caterpillar just hatched is one-twelfth of an inch long and of a dull yellowish brown colour, but when a little older it changes to a dark green. When full grown it is about an inch long, with a dark green head and body, the latter with a yellowish white stripe on each side close to the under surface, with an irregular streak of bright red running through its lower portion. The body also has a downy look occasioned by its being thickly clothed with very minute pale hairs.

The chrysalis is about seven-tenths of an inch long, attached at its base, and girt across the middle with a silken thread. Its colour is pale green with a yellowish tinge, with a purplish red line on each side of the head, darker lines down the middle both in front and behind, and with a yellowish stripe along the sides of the hinder segments.

During the heat of summer the chrysalis state usually lasts about ten days. A day or so before the butterfly escapes the chrysalis becomes darker and semi-transparent, the markings on the wings showing plainly through the enclosing membrane.

THE WHITE-LINED MORNING SPHINX (*Deilephila lineata*, FABR.)

Fig. 27.



Colours Olive, white and rose.

The white-lined morning sphinx is a tolerably common insect throughout Ontario. It is seen on the wing generally about twilight or later, although it has been met with occasionally in the day time. In its flight it much resembles the humming bird, hovering over flowers into which it inserts its long and slender tongue in search of the nectar there stored, which constitutes its food. In common with many other sphinx moths its structure is robust and its flight rapid and power-

ful: hence it is difficult to capture, and even when taken will often flutter with such force as to seriously damage the covering and structure of its beautiful wings. When its wings are fully spread they measure from three to three-and-a-half inches across, (see Fig. 27, after Riley). The ground colour is a rich greenish olive. On the fore wings there is a pale band about the middle, extending from near the base to the tip, and along the outer margin runs another band nearly equal in width, but darker and less distinct; the veins also are lined with white. The hind wings which are small, are nearly covered by a wide central rosy band, becoming paler as it approaches the body, the hinder edge is fringed with white. On the anterior portion of the body there are six longitudinal stripes or lines, while the hinder part is alternately spotted with white and black. The entire under surface is much paler and duller in colour than the upper.

"The larva," Mr. Riley says, "feeds upon purslane, turnip, buckwheat, water melon, and even apple and grape leaves, upon any of which it may be found in the month of July. It descends into the ground, and within a smooth cavity, changes into a light brown chrysalis, from which the moth emerges during the month of September."

"The most common form of the larva is that given at Fig. 28. Its colour is yellowish green, with a prominent subdorsal row of elliptical spots, each spot consisting of two curved

Fig. 28.



black lines, enclosing superiorly a bright crimson space, and inferiorly a pale yellow line—the whole row of spots connected by a pale yellow stripe, edged above with black. In some specimens these eyelike spots are disconnected, and the space between the black crescents is of a uniform cream colour. The breathing holes are either surrounded with black or with black edged with yellow. The other form is black, and characterized chiefly by a yellow line along the back, and a series of pale yellow spots and darker yellow dots, as represented

Fig. 29.



in the illustration Fig. 29, even this dark form is subject to great variation, some specimens entirely lacking the line along the back, and having the spots of different shape."

"This insect has a wide range, as it occurs in the West Indies, Mexico and Canada, as well as throughout the United States. Feeding as it does, principally on plants of but little value, and being very commonly attacked by the larvæ of a Tachina fly, this insect has never become sufficiently common to be classed as injurious."

GRASSHOPPERS OR LOCUSTS.

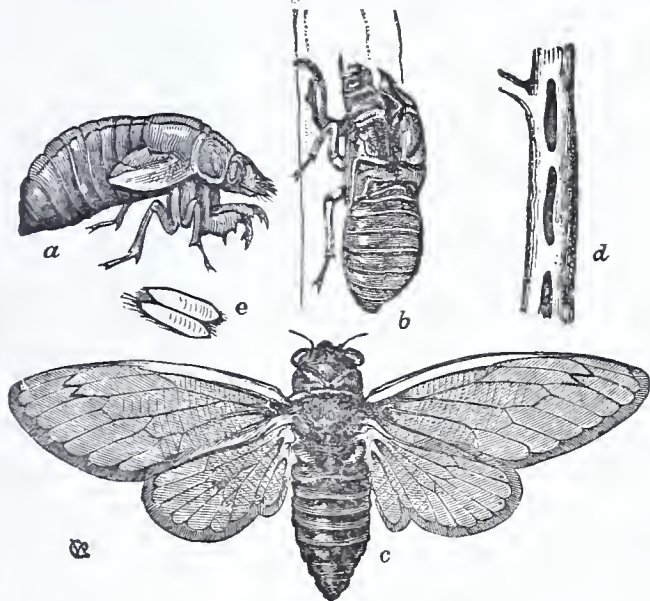
BY THE REV. C. J. S. BETHUNE, M.A.

Few, probably, of our Canadian fellow-countrymen are aware that the terrible Locust, "the scourge of nations," as it has been fitly termed, about whose destructive powers they read such appalling accounts in books of Oriental travel, is one of the insect enemies that some of the denizens of our Dominion have to contend against. And yet it is too true—as the records of the past season in our North-west Province of Manitoba abundantly prove. The locusts (or grasshoppers, as they are incorrectly termed) have laid waste great tracts of fertile country, and have brought ruin and desolation to many an unhappy settler in that far off region.

It is much to be regretted—to quote our remarks made on a former occasion*—that so much confusion exists in the popular use of terms in Natural History, and particularly in entomology, in consequence of which very serious errors become matters of common faith, much mischief is allowed to go unheeded, and the innocent are oftentimes punished for the guilty. The term "bug," for instance, is almost universally applied in the neighbouring States, and very generally in this country, to every kind of insect, so that it is no uncommon thing to hear a beautiful butterfly or lovely moth designated by the odious name of "bug," whereas the appellation belongs exclusively to those foul-smelling sucking insects of the order *Hemiptera*, which feed upon the juices of plants, and in some cases upon the blood of other insects, of animals and man. Again, the larva of almost every kind of insect is called "the grub;" larvæ that burrow into the trunks of trees and timber, "the borer," and so on to any extent. The consequence is that what is a remedy for one grub or borer, or so-called "bug," is indiscriminately made use of for the destruction of every other grub, or borer, or "bug," unmindful that the old proverb may be read in this way also—"What is one insect's meat is another's poison," and that the treatment that will exterminate one injurious insect is sometimes perfectly harmless in the case of another.

This confusion of terms is particularly unfortunate in the case of the insects that we are now treating of. Every one in this country is perfectly familiar with what is commonly called a "grasshopper," but how very few are aware that what they term a grasshopper, and see too often to think much about, is really the same kind of insect as the much dreaded, famine-producing Locust, that constituted one of the plagues of Egypt, and that is an object of so much terror wherever it prevails. A true locust it nevertheless is, and it were well, for many reasons, that our people became accustomed to call it by its right name. Our common species in this Province, while it does not possess the power of suddenly appearing in vast numbers and emigrating from place to place, occasionally becomes greatly multiplied and proves very destructive. The western locust (or grasshopper), however, differing but very slightly from our species, is, as we shall presently shew, quite as formidable a destroyer as its Oriental congener.

Fig. 30.



* *Canada Farmer*, 1867, page 87.

While the true American Locusts are commonly called grasshoppers, and the true grasshoppers are termed crickets, katydids, &c., another element of confusion is mingled with our insect nomenclature by the common practice of giving the name of locust to the cicada, a totally different insect belonging to an entirely different order. The accompanying illustration will shew the reader the difference between these three kinds of insects better than any written description. Figure 30 represents different stages in the life of the Cicada or so-called "Seventeen year Locust" (*C. Septem-decim* LINN). *a* is the pupa; *b* the empty pupa case after the perfect insect has emerged from it; *c*, the perfect or winged insect; *d*, the perforations in a twig for the deposition of eggs; *e*, the egg. Figure 32 represents a katydid or true grasshopper (*Cyrtophyllum concavum*, SAY); and Figure 31 a true locust or so-called grasshopper (*Caloptenus spretus*, UHLER).

A single glance at these illustrations will shew the reader, the main differences between the three kinds of insects that we have been referring to. We wish it, therefore, to be plainly understood that in the account that follows: we shall use the term "Locust" in reference to the devastating insect represented in Figure 31, which is so often called a "grasshopper."

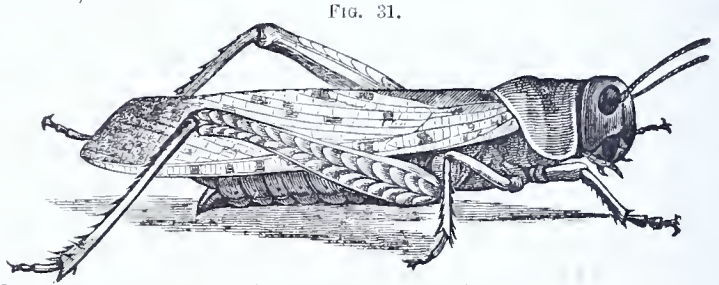


FIG. 31.

Fig. 32.

HISTORY OF THE LOCUST IN AMERICA.

From the various works that we have been able to consult we gather that visitations of locusts have occurred on a more or less extensive scale, from time to time, ever since the Central and Western portions of this Northern Continent have been occupied by Europeans. We have no difficulty, then, in believing that from time immemorial these destructive insects have played their important part in maintaining the balance of animal and vegetable life in accordance with the grand laws of the Omnipotent Creator. The earliest notice that we have found of a visitation of locusts refers back more than two centuries, to a period much anterior to the discovery of the Mississippi River by La Salle. In Gage's West Indies the following account is given of one of these visitations in Guatemala in the year 1632:—

"The first year of my abiding there it pleased God to send one of the plagues of Egypt to that country, which was of locusts, which I had never seen till then. They were after the manner of our grasshoppers, but somewhat bigger, which did fly about in numbers so thick and infinite that they did truly cover the face of the sun, and hinder the shining forth of the beams of that bright planet. Where they lighted, either upon trees or standing corn, there was nothing expected but ruin, destruction and barrenness; for the corn they devoured, the fruits of trees they ate and consumed, and hung so thick upon the branches that with their weight they tore them from the body. The highways were so covered with them that they startled the travelling mules with their fluttering about their heads and feet. My eyes were often struck with their wings as I rode along; and much ado I had to see my way, what with a montero wherewith I was fain to cover my face, what with the flight of them which were still before my eyes. The farmers towards the South sea-coast cried out, for that their indigo, which was then in grass, was like to be eaten up; from the Ingenios of sugar the like moan was made, that the young and tender sugar-canes would be destroyed; but, above all, grievous was the cry of the husbandmen of the valley where I lived, who feared that their



corn would in one night be swallowed up by that devouring legion. The care of the magistrates was that the towns of Indians should all go out into the fields with trumpets, and what other instruments they had, to make a noise and to affright them from those places which are most considerable and profitable to the commonwealth; and strange it was to see how the loud noise of the Indians and sounding of the trumpets defended some fields from the fear and danger of them. Where they lighted in the mountains and highways, there they left behind them their young ones, which were found creeping upon the ground, ready to threaten such a second year's plague, if not prevented; wherefore all the towns were called, with spades, mattocks and shovels, to dig long trenches and therein to bury all the young ones. Thus, with much trouble to the poor Indians and their great pains (yet after much hurt and loss in many places) was that flying pestilence chased away out of the country to the South Sea, where it was thought to be consumed by the ocean, and to have found a grave in the waters, whilst the young ones found it in the land. Yet they were not all so buried, but that shortly some appeared, which, being not so many in number as before, were with the former diligence soon overcome."

About a century later than the date of the above account, the locusts are recorded to have laid waste, on several occasions, all the vegetation of Mexico and Yucatan, and to have produced famine and much consequent suffering among the people. To California, they appear to have been especially partial from the earliest times. The Jesuit Father Michael del Barco, who lived for thirty years in that country as a missionary among the heathen Indians, relates that from the arrival of the Jesuits in 1697 to the year 1722, they were free from any plague of locusts, but that in this year they caused fearful sufferings among the inhabitants. In 1746 and for three years following without intermission, they again invaded the land; after this they did not appear until 1753 and 1754; and finally, before the expulsion of the Jesuits, in 1765 and the two following years. Clavigero, in his History of California, gives a very interesting account of these several invasions, and describes the appearance and natural history of the insect with much minuteness; from his work we make the following extracts:—

"The female, at the latter part of July or early in August, lays a number of fine small eggs of a yellowish colour, in a string, united with a glutinous matter, which appears like a cord of fine silk. These are deposited together and dropped into a small hole which they make in the ground with a small apparatus attached to their tails. Each female lays from seventy to eighty eggs, and sometimes more.

"The birth of these new grasshoppers has no particular time, but is dependent upon the early or late appearance of the rains, but they generally hatch during the latter part of September or early in October. . . . Their life, from birth to death, lasts ten months, during which they cast their coats twice and change their colours five times. When the wings have become of sufficient strength and the body at its maturity, they then begin to ascend into the air and fly like birds, and commence their ravages in every direction, desolating the fields of every green thing. Their numbers become so extraordinary, that they soon form clouds in the atmosphere, of which the rays of the sun cast a shadow as they fly. They unite in masses of ten to twelve thousand, always following their conductors and flying in a direct line without falling behind, for they consume every growing thing before them. To whatever height their guides conduct them to obtain a sight of their food they follow, and as soon as growing crops or any verdure is sighted, instantly the swarm will alight and speedily devour and devastate the fields around to that extent, and with that promptitude, that when they are seen by a new swarm of their fellows, there is not anything more left to injure or consume.

"This lamentable insect plague is bad enough in old and cultivated countries, but in the miserable peninsula of California, where they eat up the crops, green trees, fruits, and pastures, they cause great mortality in the domestic animals of the missions, and with the effect of their ravages on the cereals and other garden productions cause great famines and sickness among the inhabitants and neophytes of the establishments. At one time immense multitudes of these voracious insects died, infecting the air dreadfully with the stench of their corruption and decay."

In Upper California, the Franciscan Missions of the early part of the present century, have suffered in a very similar manner. About the year 1827 or 1828, they ate up—we are told—nearly all the growing crops, and occasioned a great scarcity of wholesome food; again in

1834, they "destroyed all the crops of the rancheros and missions, with the exception of the wheat." In 1838, the field crops and gardens were again nearly destroyed. In 1846, there was another serious visitation, which extended over some of what are now termed the Western States, as well as California. In 1855, to pass over lesser visitations, there came one of the most terrible of all the recorded plagues of Locusts in California. As related by Mr. Taylor, of Monterey, (Smithsonian Report, 1858), between the middle of May and October, 1855, "these insects extended themselves over a space of the earth's surface, much greater than has ever before been noted. They covered the entire Territories of Washington and Oregon, and every valley of the State of California, ranging from the Pacific Ocean to the eastern base of the Sierra Nevada; the entire Territories of Utah and New Mexico; the immense grassy prairies lying on the eastern slopes of the Rocky Mountains; the dry mountain valleys of the Republic of Mexico, and the countries of Lower California and Central America, and also those portions of Texas which resemble, in physical characteristics, Utah and California. The records prove that the locusts extended themselves, in one year, over a surface comprised within thirty-eight degrees of latitude, and in the broadest part, eighteen degrees of longitude." The Sacramento newspapers of that year were filled with details of the plague; most accounts compared the swarms, when in flight, to dense snow-storms; they consumed everything before them—the foliage of trees, orchards, gardens, vineyards, fields of young grain, of crops and vegetables—everything was eaten up in a particular locality in a single day, leaving the ground a withered, blackened desert. That summer of 1855, was observed to be the hottest and driest that had been known for ten years."

During the next two years, 1856-7, the plague was almost entirely confined to the region lying east of the Rocky Mountains, and extending in places as far as the Mississippi River; throughout the States of Minnesota, Nebraska and Kansas, the locusts were especially destructive. Ten years later, in the summer of 1866, another noteworthy visitation took place throughout the same region. A correspondent of a Rock Island, Ill., paper (see *Practical Entomologist*, vol. ii., page 3), thus describes the plague in Nebraska: "The last day of August, near the middle of the afternoon, quite a number of grasshoppers were seen alighting, and that number rapidly increased till a little before sunset. The next morning they appeared much thicker, but were only so from having crawled more into the open air to sun themselves. About nine o'clock they began to come thicker and faster from a northerly direction, swarming in the air by myriads, and making a roar like suppressed distant thunder. By looking up to the sun they could be seen as high as the eye could discover an object so small, in appearance like a heavy snow storm. Each grasshopper very much like a very large flake, save that it passed by instead of falling. The number was beyond imagination, the air was literally full of them and continued so till late in the afternoon, countless millions passed on leaving other countless millions covering the earth and devouring the vegetation." Another writer from Kansas states that "Yesterday, September 10th, the locusts made their appearance here, and are devouring everything green. They almost darken the sun in their flight. I put in 65 acres of wheat in the last week of August, which looked fine, but it has nearly all disappeared; by to-morrow night there will not be a spear left. Early sown wheat will be totally destroyed." From the description given by another writer in Kansas, we may quote the following graphic account:—"There is something weird and unearthly in their appearance, as in vast hosts they scale walls, housetops and fences, clambering over each other with a creaking, elashing noise. Sometimes they march in even regular lines, like hosts of pigmy cavalry, but generally they rush over the ground in confused swarms. At times they rise high in the air and circle round like gnats in the sunline. At such times, I think, they are caught by currents of our prevailing westerly winds and are thus distributed over vast tracts of country." The foregoing extracts will give our readers some little idea of the mode of appearance and the destructive powers of the locusts in the west. We might fill pages, a volume indeed, with similar accounts.

The next year 1867, and to some extent also in 1868 the locusts reappeared throughout the same region, and extended further to the eastward as well as westward. They proved more or less destructive in Western and Central Iowa, and in North Western Missouri, as well as almost all over Nebraska, Kansas, Texas and Utah. They have never, so far as we have been able to ascertain, passed to the eastward of the Mississippi River.

In 1869 and 1870, the ravages of the locusts seem to have been confined on this side of the Rocky Mountains, to portions of Nebraska, Colorado and Utah.

THE PLAGUE OF LOCUSTS IN 1874.

Let us now turn to the terrible visitation of the present year, from the effects of which so many thousands are now suffering the privations of famine throughout immense tracts of country.

Last year (1873) the locusts or grasshoppers were stated to have inflicted considerable damage upon crops of various kinds in some of the Western States, principally Nebraska and Kansas; here and there also in Minnesota, Iowa and Dakota there were comparatively trifling visitations. But in the month of July of this year there began one of the most serious invasions that has ever occurred in the west. In point of numbers and in extent of area affected, the plague was probably no greater than on some previous occasions, notably that of 1855 that we have referred to above; the great difference, however, is caused by the fact that twenty years ago the country west of the Mississippi River was an almost uninhabited wilderness of prairie, while now it is traversed by a net work of railways, covered with populous towns and villages, and occupied to a very large extent by multitudes of industrious people. Twenty years ago the locusts affected the food supply, perhaps, of the buffalo, the Indian, and the scattered frontier settlers, but now their ravages cause destitution and misery in tens of thousands of homes.

Up to the beginning of July this year, all looked bright and fair for the western farmer. His crops of all kinds were, as a rule, growing luxuriantly; the prospect of a bountiful harvest was quite as good as usual. After that date, however, sooner or later in different localities, all these bright prospects were overclouded, in many instances utterly destroyed. The following extracts from various newspapers will abundantly tell the tale.

As early as the 19th of July a correspondent of the *Prairie Farmer* writes from Howard County, Nebraska: "Corn and potatoes were doing well until recently, when the grasshoppers [locusts] put in an appearance, and the result undoubtedly is, at the present moment, that there is not ten per cent. of these crops and of late oats left in this and the two neighbouring counties; and it is very doubtful if the countless millions of Vandals will leave a vestige of any green thing. The result must be almost certain starvation for new-comers, and must retard the development of this beautiful country for many years."

A lady correspondent of the same paper writes a few days later from Butler County, also in Nebraska:—"The low-hung clouds have dropped their garnered fullness down. But alas! and alack! they were not the long-looked-for rain clouds, but grasshoppers. As I told you before, they passed over on the 23rd, only a few alighting; but a strong south-west wind on the 24th brought back countless millions; and on the 25th their numbers were fearful to contemplate. They would rise in the air when the sun shone hot, but as it grew cooler they came down like the wolf on the fold. They settled like huge swarms of bees on every living thing. Fields of corn that had been untouched before were now stripped of tassel and blade. A field of early corn was being eaten so fast, that the girls went to save a few ears, instead of going to visit a sick schoolmate according to promise. Trees were so loaded with the pests, that those four and five feet high bent down till the tops touched the ground, and in some instances broke off; for three dreadful hours they dashed against the house like hail. So many came in at doors and windows that every aperture was closed; but not till they were so thick on the windows, that we were forced to make a business of slaying. The 25th of July will be remembered by the citizens of this and some other counties as the dark day, when desolation and devastation stared us in the face. * * * The wheat which was at first thought to be out of harm's way was cut off about one-fourth by the destroying angels. A statement in our county paper says the average will be about 8 or 9 bushels per acre. After the grasshoppers stopped their depredations, there were several damp cloudy days, that brought out new tassels and silks on the corn, but more than a week of hot, dry weather, with scorching winds checked its growth, so there will be none, excepting a very few fields that partially escaped. Turnips have been grown since the rain; and it is to be hoped there will yet be some potatoes; sweet potatoes were not hurt so badly as the common potato. Broom corn, cane and Hungarian grass were unscathed."

A writer from St. Paul, Minnesota, to the paper above mentioned, says that the locusts "have undoubtedly destroyed five hundred thousand bushels of wheat, and are likely to destroy another half million of bushels." Later on in the season the *St. Paul Press* publishes the following statement in reference to the plague of locusts in Minnesota:—"It is safe to

estimate the tilled area in the ravaged district at 275,000 acres, and of the area in wheat in that district at 200,000 acres. Of this area, probably not less than 150,000 acres have been destroyed. This represents not less than 2,500,000 bushels of wheat devoured in the germ by the grasshoppers, or about one-twelfth of the wheat crop of the state. Add to this area 50,000 acres of oats, at 33 bushels per acre, or 1,320,000 bushels in all, or one-twelfth of the oat crop of the state; 20,000 acres of corn, at 32 bushels per acre, 340,000 bushels, or one-twelfth of the corn crop of the state, and perhaps 20,000 acres more in rye, buckwheat, barley, potatoes and other crops—and the full extent of the grasshopper havoc cannot be easily estimated."

Our readers may further judge of the extent of the calamity and sufferings consequent upon it, from the following Pastoral Letter, issued by the Bishop of Minnesota, and appointed to be read in all the Churches in his Diocese:—*To the Clergy and Congregations of the Diocese of Minnesota*: You are aware that several counties of the State have been desolated by locusts. In May I visited Martin county and saw the beginning of their ravages. I laid the facts before the Governor. The plague has increased. Many homes are desolated. They have the right to look to us for relief. They are our own flesh and blood. They are our brothers. They are God's children. The scourge is an awful one. It may be for *our* sins. It may be to try our faith in God. It may be to test our humanity.

I ask your prayers and your alms. I recommend that an offering shall be taken up on the last Sunday in July, and that a further special contribution of money and provisions shall also be taken at our Annual Harvest Home Festival.

Please send your offerings to Hon. Isaac Atwater, Minneapolis, who will send them to the Committee in St. Paul.

Praying God to bless you,
Your friend and Bishop,

H. B. WHIPPLE.

Extract from a Widow's letter in Brown County.

"I mortgaged my farm to get seed last Spring. All is lost. What to do I do not know. It would take a tear out of a stone to hear the people talk. I had a nice piece of barley almost ready to cut. There is nothing left but the straw, the heads lying thick on the ground. Dear Bishop, I am almost heart-broken, and nearly crazy, to think of the long, cold winter, and nothing to depend on. May God help us. May the Lord look to every orphan and widow, and put it in the hearts of His children to help."

"The widow must not plead in vain."

The Bishop also issued a form of prayer for relief from the plague of locusts, to be used in the Churches throughout his Diocese.

From the September "Report of the Department of Agriculture," at Washington, we cull the following note from Kansas:—"The late summer and fall crops have been almost entirely destroyed by grasshoppers. The common jumping grasshopper did much damage through the early part of the season, but about the middle of August clouds of the flying ones made their appearance over the county, devouring and destroying vast quantities of vegetation. Gardens were quickly eaten up, corn-fields were stripped of leaves, and in many cases the corn was entirely eaten off; fruit trees are left with naked branches, and in many cases the half-ripened fruit is left hanging on the trees, presenting a sickening sight of death and destruction.

In addition to the actual loss by devastation, the loss caused by discouragement will be greater. Years of patient waiting, hard work, and self-sacrifice have been destroyed in a few days, with no known remedy for protection—just as the fruits of labour were beginning to be realized, destruction came—and the question with many is, "Is it of any use to try again?"

Here is a field for the Department of Agriculture. Some method of protection or relief must be had against the destruction of this insect, or an immense tract of magnificent country will never be what it would without this curse. I am one of those who believe all such things may be controlled by some practical method; it only requires study, enterprise and means to learn how. This county (Doniphan) could well afford to pay \$100,000 for a guarantee that no grasshoppers should ever trouble it again. I have learned that vegetation highly cultivated and growing vigorously is less liable to be destroyed than when on the decline or growing feebly. Thus it is we often see a single tree in an orchard eaten even to the bark,

while others of the same variety are not damaged so much ; and upon examination it will be invariably found that those mostly eaten were diseased, or had their vitality in some way impaired. This thing was noticeable when the same kind of insects were here six or seven years ago. Of all fruit trees, apple and pear trees suffer the most, while peaches, plums and cherries suffer the least. They eat the leaves off the apples, and leave most of the apples on, but of the peaches they will eat the fruit and leave the foliage ; but in many instances, when vegetation is not plenty, I understand they clean all as they go, and I have seen instances of this kind. The damage to vineyards in this county is not so great. They do not seem to relish grapes, and are satisfied by eating off the stems and letting the bunches fall to the ground. There will not be enough corn in this county to feed what stock there is in the county as it should be fed."

The same report states that "the plague"—as it justly terms it—is reported in two counties in Wisconsin, seven in Minnesota, five in Iowa, four in Missouri, thirty in Kansas and seven in Nebraska. It adds that "the wide-spread destruction which they (the locusts) have caused in the north-west has not been adequately described. In many places large masses of people will probably suffer during the coming winter for the necessaries of life, their crops having been swept by this remorseless enemy."

The next Monthly Report—that for October—records the prevalence of the plague in two more counties in Minnesota, two more in Iowa, four more in Missouri, four more in Kansas, four more in Nebraska, three in Texas, two in Colorado, and one in California. The following letter from Kansas is recorded "to give some idea of its ravages :"—"The farmers in my county had their land for wheat prepared in good time, and in a better condition than I ever saw. On the 6th of September the grasshoppers made their appearance all over the county. Farmers became alarmed and did not sow any wheat. About the 18th to the 20th they appeared to go away. Farmers commenced sowing and got in about two-thirds of their crop. On the 28th and 29th they came the second time, filling the air, reminding one of a snow-storm in December. Some who had sown early had wheat up nice, but you cannot find a spear in any place. Wheat which was sown before the grasshoppers came the first time has been eaten down, until the grain has finally ceased to grow. I am candidly of the opinion that every acre which is sown to-day in this county will have to be sown again. There is no other chance for it, and the great trouble will be that so many of our farmers have sown all their seed and are not able to buy again. And what will they do? Some who have not been two years on their claims are leaving them and going over into Missouri and Arkansas to winter—to find something to live upon."

We might go on to an almost unlimited extent with similar descriptions of the wide-spread devastation caused by these insects, and the consternation they have produced throughout the west. Every agricultural newspaper and a large number of city papers have published throughout the past season similar records of ruin and suffering. To assist their brethren in the afflicted regions, large sums of money have been contributed both by State Governments and by individuals ; but it is greatly to be feared that the utmost liberality will hardly save from ruin, though it may relieve temporarily, many farmers who had recently settled on those hitherto attractive plains. Not only, it should be remembered, have they suffered from a dire plague of locusts, but they have also been the victims of a long-continued drought ; accompanied in some localities by a terrible hot wind, resembling the *sirocco* that blasts southern Europe with the dry heat of the African desert ; to add also to their series of calamities, the Chinch-bug* destroyed in many places those crops that the Locusts spared.

To illustrate the reality and intensity of the sufferings that we have alluded to, we shall give one extract only out of a large number that might be quoted. The writer of a letter to the *Prairie Farmer*, dated Kearney, Nebraska, November 16th, thus describes the condition of things in his neighbourhood :—"Your readers have been pretty fully posted as to the ravages of locusts over this entire region, the devastation extending from Central Minnesota to the southern limit of Kansas, the whole country being almost as utterly destroyed, so far as provisions are concerned, as if it had been swept by the scathing flames. I speak more understandingly of my own neighbourhood, and shall endeavour to state facts that may be firmly relied upon, and which can be verified if necessary, by the testimony of others in my own

* For a description of the Chinch-bug, see the report of the Entomological Society of Ontario, for 1871.

vicinity. The wheat crop, what there was of it, considering the dry weather, was good. But fully one-half of the settlers had no wheat at all; their sole dependence was corn and potatoes. In many instances the very uncertain product of prairie sod. Thus nearly half of our people were dependent solely upon the two above articles, both of which were almost entirely swept away by drought, bugs and locusts combined. *Every* family nearly, that was able to do so, having friends in Iowa and Missouri, have gone there to winter, some may return, others never will. Many proved upon their claims and have left the country forever. The number of actual homestead settlers is thus reduced fully one-half in my own neighbourhood, and of that one-half, not one family in ten have provisions, fuel or clothing to last them through the winter. Fully two-thirds have not food enough to last until the 1st of December. I find from conversation in Kearney, with settlers both north and south for a distance of thirty to fifty miles, that the same statement holds true over almost the entire region. Thus notwithstanding the *cry* of some of our papers that "we are not beggars," more than two-thirds of those now on their homesteads must either beg or starve. In less than thirty days there will be starvation and death unless these needs are promptly met.

"There is no corn, no oats, no feed of any kind for stock, except what is shipped in from a distance. There is no fuel except coal, at from \$8 to \$11 per ton. There is no work, no money. There is no seed corn, and in very many instances, no seeds of any kind for another year's planting. On the 13th inst., I met two of my neighbours. One has a family of six to provide for, three of them young children. Says he: 'I have just flour enough to last until Saturday night.' The other has a family of ten, four of whom are sick, and have been since September. One child, a bright boy of some four years, has lost the entire use of his limbs, and now has to have the care of a helpless babe. This man has flour for ten days, and potatoes that will enable him to get along for a week or two longer. Last winter this family of children were entirely without shoes or stockings, with clothing just sufficient to cover nakedness, and ragged at that. The writer of this article has flour for a week—fifty pounds—and pays for it in breaking one acre of prairie, thus giving three dollars in work for \$1.20 worth of flour. He does not state this complainingly, being glad to get work to feed his five babies at any price. I merely give these three cases as a sample. While I give but three, there are many others all around me in fully as deplorable a situation. This want extends over the whole area of country, west, north and south, and the farther the settlement is from the supplies, the greater the wants and privations of the settlers."

THE PLAGUE OF LOCUSTS IN MANITOBA.

Thus far we have been describing the extent and the terrible results of this year's plague of Locusts in the Western States of the Union. We have now, unhappily, to record its occurrence in our own new Province of Manitoba, which adjoins the State of Minnesota, so frequently referred to above. From the following record of visitations previous to this year, it will be observed that they were, in almost all cases, simultaneous with those in the neighbouring States, that we have described in the earlier part of this paper. For this record we are indebted to the letter of the Winnipeg Correspondent of the *Toronto Globe*, which appeared in that paper on the 5th of August last:—

"Grasshoppers first appeared in Red River towards the end of July, 1818, six years after the commencement of the settlement. They covered the settlement belt, but did not utterly destroy the wheat crop, it being nearly ripe at the time. Barley and other crops were swept away. They deposited their eggs and disappeared, and the following spring the crop of young grasshoppers was immense. These departed before depositing their eggs, but devoured all vegetation on their route, thus destroying all the crops of 1819. Great numbers came in during the season of 1819 and deposited their eggs, so that in 1820 the crops were again all destroyed. Thus for three successive years were the crops in this country destroyed by these pests. They then disappeared for thirty six successive years, the next visitation being in 1857, when they visited the Assiniboine settlement, doing but little injury beyond depositing their eggs. The following season their progeny destroyed all the crops within their reach. In 1864 they again appeared in considerable numbers but did little injury to the wheat crop. The following year the young grasshoppers partially destroyed the crops, leaving many districts entirely untouched. The largest swarm ever known came in August, 1867, but the crops were so far advanced that season that they did but little in-

jury. Their eggs produced such immense swarms the following spring that they destroyed everything that had been sown throughout the settlement, and famine ensued. In 1869 they again visited the country, but too late to do much harm. The season following, however, they destroyed most of the growing crops. In 1872 immense hordes of these winged pests again visited a part of the country about the beginning of August. The country west of Headingly escaped, and generally the wheat was not much injured, but they played sad havoc with the gardens. Nothing was sown the following spring throughout the infested district, but throughout the western settlements a large crop was grown and saved."

From the same source we have obtained the following particulars respecting the ravages of the Locust in different parts of the Province:—

"THE SOUTH.—From West Lynne (Pembina) northward as far as Scratching River the oats and barley have been entirely destroyed, and the wheat partially.

"PALESTINE.—The latest reports from this settlement confirm the accounts that the settlement is laid waste.

"MANITOBA LAKE.—The shores of this lake are strewn three feet in many places with dead grasshoppers, the wind having driven them into the lake, where they were drowned and cast ashore.

"THE BOYNE SETTLEMENT.—They are very thick here, and have completely destroyed the oats and barley, and about half ruined the wheat.

"PORTAGE LA PRAIRIE.—From Poplar Point to the Portage the fields are swarming with grasshoppers, which have devoured the crops. Scarcely anything has escaped.

"RAT CREEK.—In this neighbourhood it is reported that the crops of Kenneth McKenzie, Hugh Grant and others, are being destroyed, and that the former had commenced cutting his oats and barley for fodder rather than let the pests take all.

"ROCKWOOD.—The crops in this settlement have suffered severely. Oats and barley completely destroyed, and wheat badly injured.

"WOODLAND.—Most of the settlers in this neighbourhood are entirely cleaned out.

"COUNTY OF PROVENCHER.—All the crops along the Red River, from Pembina to Stinking River, have been eaten up, excepting, in some instances, a portion of the wheat and potatoes have escaped.

"WINNIPEG.—The gardens in this city, and the oats and barley in the neighbourhood, are being destroyed. During the evenings, at the going down of the sun, they seek the board fences and sides of houses in such numbers that in many cases it is impossible to distinguish the colour of the houses, or the material of which they are built."

As yet we do not know whether the Locust ravages are wont to extend over the great fertile region to the north-west of Manitoba—that magnificent agricultural region drained by the Saskatchewan River; we hope, and we are strongly inclined to think, that the plague, if noticeable at all, is there trifling in character and moderate in extent. Should it be otherwise, should that "fertile belt" be as subject to these visitations as the States to the south of it unhappily are, it must prove a great hindrance to its rapid settlement. If, on the other hand, it possesses an immunity not shared in by the Western States, it will certainly draw from them, before many years are over, and as soon as railway facilities are afforded for transportation of goods and produce, a very large portion of those settlers who are now eaten out of house and home. We fully expect to see the tide of immigration which for a few years past has been setting so strongly towards the plains of Kansas and Nebraska, turned towards our own more highly-favoured, even though more northern regions of Assiniboine and Saskatchewan.

DESCRIPTION OF THE INSECT.

Let us turn now to a description of the insect respecting whose powers of destruction we have heard so much. As we have already remarked, there is very little difference in appearance between our common "grasshopper" and the famine-producing Locust of the West. They both belong to the same genus (*Caloptenus*) of the family Acrydidae and of the order of Orthoptera—straight-winged insects. The Acrydidae, or Locusts, are distinguished from their kindred, the true grasshoppers, by the following characteristics:—The former have short antennæ (or feelers), never exceeding the body in length; the latter have very long thread-like antennæ. The tarsi, or feet, of the former are three-jointed; of the latter four-jointed. The female of the former has the tip of the abdomen furnished with four very short

bony pieces, two of which curve upwards and two downwards (they may be observed in figures 33 and 34); the female of the latter has a long curved, often sword-shaped, ovipositor. The former, again, live upon the ground; the latter for the most part on grass and trees.

All Orthopterous insects—including, of course, those we are now treating of—undergo what is termed an incomplete metamorphosis—that is to say, their larvæ and pupæ resemble all along the perfect insect, except that the wings are not fully developed and the size of the mature insect is not attained. To make our meaning clearer, we may mention that Lepidopterous insects (butterflies and moths) undergo a perfect or complete metamorphosis; as every one knows, the caterpillar, or larva, is totally different from the winged insect, while the chrysalis or pupa is entirely different from either. In food, habits and appearance, the insect undergoes a complete change at each metamorphosis. In the case of Locusts, on the contrary, one can hardly say with certainty when the larval state ends and that of the pupa begins; or when, again, the pupal condition merges into that of the perfect insect.

The genus *Caloptenus*, to which we are now confined, is represented almost all over the world. In North America eight different species have been described by entomologists, but we are inclined to think that some of these are little more than varieties of others. Three species only are prevalent in large numbers—viz., *C. spretus*, *C. femur-rubrum*, and *C. bivitatus*; the last mentioned does not occur in Canada, so far as we are aware, and is of small importance economically as compared with the other two. We are thus reduced to the two species that we spoke of at the outset: our common red-legged Locust, or “grass-hopper” (*Caloptenus femur-rubrum* Burm.), represented in figure *b*; and the hateful Locust (*C. spretus* Uhler), figure *a*.

FIG. 33.



The reader will observe that there is but a very slight difference in appearance between the two species. The left hand, our common species, only dif-

FIG. 34.



fers, one may say, from its most destructive fellow on the right, by its having shorter wings. It is owing to this difference in length and expanse of wing that the one species is confined to the neighbourhood where it was born, while the other rises aloft into the air, and is literally “borne upon the wings of the wind” to regions far away from its place of birth.

As the Red-legged Locust must be so familiarly known by every one—during most summers, indeed, it is hardly possible to walk a few yards in the open air without startling numbers into flight—and as it is fairly represented in the above figure (*b*), we may content ourselves with quoting the following brief description by Dr. Harris. The insect is “grizzled with dirty olive and brown, a black spot extending from the eyes along the sides of the thorax; an oblique yellow line on each side of the body beneath the wings; a row of dusky, brown spots along the middle of the wing covers; and the hindmost shanks and feet blood-red, with black spines. The wings are transparent, with a very pale, greenish-yellow tint, next to the body, and are netted with brown lines. The hindmost thighs have two large spots on the upper side, and the extremity black; but are red below, and yellow on the inside. The appendages at the tip of the body in the male are of a long triangular form. Length from three quarters of an inch to an inch; expansion of the wings from $1\frac{1}{4}$ to $1\frac{3}{4}$ of an inch.”

The Hateful Locust (*C. Spretus*), figure *a*, can scarcely be distinguished in colour or general appearance from the foregoing species; the principal difference, as already stated, is in the length of the wings. In this species they are about one-third longer than the body of the insect; they are quite transparent with slightly dusky nerves, and when seen high up in the air against the sun, have the appearance of large snow-flakes. The eggs are deposited in the ground, in a cocoon-shaped mass, covered with a tough, glutinous secretion, and vary in number from fifty to a hundred. They are laid in the latter part of the summer and remain in their place of deposit until the following spring; usually they hatch out in March, making their appearance with the earliest vegetation of the locality. There is a good deal of difference of opinion with regard to the head-quarters of this insect; many writers affirm that all the swarms comes from the cañons of the Rocky Mountains; others again, and with more reason, we believe, hold that they breed throughout all the mountain valleys and plains of the west, but chiefly in those vast tracts of uninhabited country, lying on the slopes of the Rocky

Mountains in Arizona and New Mexico ; they breed also, there can be no doubt, in the regions that they invade, but owing to differences of climate, these broods do not always mature. They delight most in a very dry, hot atmosphere.

Like many other species of Orthoptera, the males produce sounds by means of an apparatus that may be "likened to a violin, their legs being the bows, and the projecting veins of their wing-covers the strings. When a locust begins to play, he bends the shank of one hind leg beneath the thigh, where it is lodged in a furrow designed to receive it, and then draws the leg briskly up and down several times against the projecting lateral edge and veins of the wing-cover. He does not play both fiddles together, but alternately, for a little time, first one and then the other, standing meanwhile upon the four anterior legs and the hind leg which is not otherwise employed." (Harris.) When in flight, the swarm produces a loud pattering sound, which as Dr. Thomas remarks, is probably due to the beating of the air by the wings, as it is not confined to the male sex. If any of our readers are curious upon the subject of insect music, they will find an interesting paper upon "the Songs of the Grasshoppers," by our much esteemed friend, Mr. Scudder, in the *American Naturalist* (vol. 9, page 113); in it not only is the apparatus described, but the notes are set to music, and no doubt can be sung by any accomplished vocalist!

Before closing this portion of our remarks, we would acknowledge our indebtedness, and call attention, to the admirable "Synopsis of the Acrididæ of North America," by the Rev. Cyrus Thomas, Ph.D., published by the Government of the United States as a portion of Dr. Hayden's Report on the U. S. Geological Survey of the Territories. It is magnificently printed in quarto form, and is a complete monograph of the family. We take this opportunity of thanking Dr. Hayden for his courtesy in favouring us with a copy.

MEANS OF REDUCING THE RAVAGES OF THE LOCUSTS.

When a species of insect comes in countless millions suddenly, without any forewarning, upon a locality hundreds of miles away, it may be, from its place of birth, and devours in a single day every green thing upon the surface of the country, it seems almost impossible to suggest any remedy. Something, however, may, we believe, be done, but any measure to be in the least degree efficacious must be adopted universally over a large area of country. Before considering any method of combatting the plague, we must mention one remedy that has been received by the press with some degree of amusement, though gravely propounded by the editors of the *American Naturalist*. After referring to the destitution in Minnesota and the application from its State authorities to the general government for aid, they put the question:—

"Why should not the grasshopper be eaten in turn?" Why not, indeed? For, as they state, "the grasshopper, or locust of the East, is universally eaten in portions of Africa and Western Asia, and pronounced a nutritious and palatable article of diet by Arab chiefs as well as Hottentot savages. They are eaten roasted whole, minus the legs, or roasted and powdered. We would recommend that experiments be made as to the best modes of preparing the locust for food. They should be thoroughly cooked to guard against parasitic worms. Not willing to urge the use of grasshoppers as food for others, without first eating them ourselves, we may say that we have found the grasshopper, first killed by boiling water, and then fried in butter, at least as palatable as many articles of food eaten by civilized people; and to people actually famishing, as is said to be the case in Minnesota, it will be worth their while to avail themselves of a food stuff which millions, perhaps, of people in other lands regard as wholesome."

In corroboration of this use of the locusts, we may add, that Dr. Livingstone speaks highly of the locust as an article of food in Africa, and considers them superior to shrimps. Honey, when it can be obtained, is often eaten with them, and, while improving the flavour, renders them more digestible. We need hardly remind our readers that this was the food of St. John the Baptist in the wilderness. The ancient historian, Herodotus, relates that locusts are used for food, being first dried in the sun, than reduced to powder, and drunk in milk. In his well-known work, on South Africa, Cumming states that "Locusts afford fattening and wholesome food to man, birds and all sorts of beasts; cows, horses, lions, jackals, hyænas, antelopes, elephants, &c., devour them. Our hungry dogs made a fine feast on them. . . . We roasted a quantity for ourselves and our dogs." Kirby and Spencet

(People's Edition, page 173.) state that, "as locusts are the greatest destroyers of food, so as some recompense, they furnish a considerable supply of it to numerous nations." After quoting a number of authorities for this statement, they add that "they are preferred by the Moors to pigeons; and a person may eat a plateful of two or three hundred without feeling any ill effects. They usually boil them in water half-an-hour (having thrown away the head, wings and legs.) then sprinkle them with salt and pepper, fry them, adding a little vinegar." We trust that the editors of the *Naturalist* will try this recipe next summer! Among the food products of the North American Indian (Report of Agricultural Department, Washington, 1870,) we find enumerated grasshoppers or locusts, which are eaten by the Diggers of California and the Plains. They roast them in holes in the ground and mix them with powdered acorns; sometimes they make of them a soup or mush. Mr. Taylor, however, (Smithsonian Report, 1858,) referring to the same custom, declares that this kind of food is always found to sicken the Indians, and that this result is vouched for by the early settlers and the natives, and also by many travellers and voyagers who have visited California and the Rocky Mountain country, and by the Jesuits of Lower California. From these statements we may infer that the locusts on the western side of the Rocky Mountains, considered to be a distinct species from the *C. spretus* of the eastern side, are unwholesome, but it remains to be proved that a nutritious article of diet may not be obtained from the latter. Certainly, it is an experiment worth trying; if successful, we should have a double benefit—the lessening of the numbers of the locusts, and a supply of food wherewith to meet the famine that they have produced. Such a fate for the invaders would be true poetic justice.

In the Smithsonian Report for 1858, to which we have already referred, there is an interesting article, translated from the Russian of V. Motschulsky, in which much valuable information is afforded respecting the mode of dealing with locusts in Southern Russia and other neighbouring countries with regard to natural remedies. He states that "whole generations of them succumb to the climatic influence of those countries to which, impelled by hunger, they betake themselves. Winds and storms not unfrequently cast vast swarms of them into lakes and seas, and other millions perish in crossing rivers. Frogs, lizards and various birds, especially of the starling, blackbird, lark, crow, jackdaw, stork and other species devour them with great avidity. Domestic fowls, as geese, ducks, turkeys and chickens are exceedingly fond of such food." Among insects several species of ichneumons (Hymenoptera) destroy them both in the egg and larval states. He concludes that "of the eggs laid by the locusts about one-tenth only succeed in passing through all the transformations of their existence, and with this tenth part alone it comes in contact with the husbandman. But even this is sufficiently great to furnish matter for reflection to every one who knows by experience what an attack of locusts is."

After describing a large number of artificial modes of contending against the locusts, some of which are quite useless, and others more or less successful, he draws up a number of general conclusions. Those at all applicable to North America we shall quote, with a few remarks upon them.

(a) "It is necessary to observe in the autumn, especially after a hot summer, where the locusts have deposited their eggs, and to accustom persons appointed for the purpose to do so." Much might, we think, be done in this way both by the State authorities in the west, by municipalities and by individuals.

(b) "As soon as the labours of tillage will permit, people should be sent out in the fall to collect the locusts' eggs, provided with instruments for turning up the ground. If the eggs are deposited where ploughs and harrows can pass, these should be made use of. The egg-tubes of the locusts should be poured into sacks, and either measured or weighed, and a suitable award paid for the amount collected, so as to stimulate numbers to busy themselves in this useful labour." If a certain price per bushel or hundred-weight were offered for the egg-cases by the various local authorities in the regions affected, not only would the numbers of the locusts be greatly reduced, but remunerative employment would be afforded to those who have been suffering by their ravages. In many places the locusts deposit their eggs where they have just ravaged the fields, consequently the inhabitants will not have far to go in order to find the germs of the next year's trouble. It would be desirable, too, that well-equipped expeditions of competent persons should be sent out to explore the regions bordering on the Rocky Mountains, from which the swarms emanate in the first instance.

(c) "All the places where locusts' eggs are found should be ploughed over, if possible,

two or three times very late in the autumn. Special attention should also be given to bar-spots in the fields, where not unfrequently great quantities of egg-tubes may remain unobserved." This plan of deeply ploughing under the eggs of the grasshoppers, or of ploughing them up so as to expose them to all the changes of the weather, has been found very effective in Manitoba and other places.

(d) "Breeding large quantities of domestic fowls and training them to feed on young locusts, is exceedingly advantageous to the husbandman." Geese, chickens, turkeys and guinea-fowl are especially mentioned. This plan would be of very slight use as a protection against the migrating swarms of locusts, but it might be of some little value in places where they breed. It is well known that a large brood of turkeys is invaluable to a farmer where the common red-legged locust abounds.

(e) If the locusts settle anywhere in a thick mass, large numbers may be destroyed in the evening, when they are quiet, by means of heavy iron or wooden rollers drawn by horses or oxen. This method might be of some slight advantage if generally adopted, but usually, by nightfall, most of the damage is done.

A large number of other methods are mentioned, but they are entirely inapplicable to the vast and thinly populated regions of the west.

A remedy is much employed, on the other hand, in America which could not be made use of in Russia, viz., fire. It is only during dry and very hot weather that the invasions take place. When a swarm has once alighted and has commenced the work of destruction it is often practicable to set fire to the fields and crops in places and thus kill or drive away the destroyer. In this case the remedy is almost as bad as the disease, but yet it has been adopted in many instances with good results.

Noises made by trumpets, guns, cannons, &c., sometimes drive away a small body of locusts, but they are utterly useless when the invasion takes place on a large scale.

On the whole, it seems as if man can do but very little to ward off the attacks of this fearful scourge. Still it is proper that every effort should be made to find out the exact habits of the insect, and the particular localities from which it emanates; it is fitting, too, that no means should be left untried that affords any prospect of lessening the destruction that they occasion. The Arabian fable we cannot but feel, has much truth at the bottom of it; they represent a locust as saying to Mahomet, "We are the army of the Great God; we produce ninety-nine eggs, if the hundred were completed we should consume the whole earth and all that is in it." While the people of the West are in the hands of Providence to protect them from such mighty armies as these, they can best help themselves by going to the root of the evil—that is to say, by reducing to the utmost extent the numbers of eggs that are laid for future broods.

After all the accounts that we have given of these insects, we feel that nothing can equal in sublimity and correctness the description afforded by the Prophet Joel, ii. 2—11.

"A day of darkness and of gloominess, a day of clouds and thick darkness, as the morning spread upon the mountains: a great people and a strong; there hath not been ever the like, neither shall be any more after it, even to the years of many generations. A fire devoureth before them and behind them a flame burneth: the land is as the garden of Eden before them, and behind them a desolate wilderness; yea, and nothing shall escape them. Like the noise of chariots on the tops of the mountains shall they leap, like the noise of a flame of fire that devoureth the stubble; as a strong people set in battle array. Before their face the people shall be much pained; all faces shall gather blackness. They shall run like mighty men; they shall climb the wall like men of war; and they shall march every one on his ways, and they shall not break their ranks, neither shall one thrust another, they shall walk every one in his path, and when they fall upon the sword they shall not be wounded. They shall run to and fro in the city, they shall run upon the wall, they shall climb up upon the houses, they shall enter in at the windows like a thief. The earth shall quake before them, the heavens shall tremble, the sun and the moon shall be dark, and the stars shall withdraw their shining, and the Lord shall utter His voice before His army, for His camp is very great, for He is strong that executeth His Word, for the day of the Lord is great and very terrible, and who can abide it?"

While the foregoing paper was passing through the printer's hands, we cut from the *Albany Country Gentleman*, the following official statement of the misery caused by the plague of

Locusts in the Western States, which fully corroborates any expressions that we have used above:—

“THE WESTERN GRASSHOPPERS.—Commissioner-of-Agriculture Watts has issued a synopsis of information received concerning the extent of suffering from the grasshopper plague, which we copy, somewhat condensed:

“*First.*—The area of this visitation comprises a zone 200 to 225 miles wide, extending from the settlements of Southern Dakota, through Nebraska and Kansas, over 500 miles in length, and inclining to south. A few western counties of Iowa and Minnesota report injuries. The extent of territory visited by these insects in 1874 very considerably exceeds 100,000 square miles.

“*Second.*—The grasshopper district west of Missouri embraces population of Kansas, Nebraska and Southern Dakota, amounting to over 500,000 in 1870, with a large increment since. Including counties east of the Missouri in Iowa and Minnesota more or less affected by the plague, I think it not extravagant to assign 750,000 as the approximate population of these districts.

“*Third.*—In Kansas, cases of total destitution in 50 counties reported vary from 40 to 2,000; reports from counties not in this list show injuries as severe as in any others. The average of such cases 555 in each county. These do not include cases of partial destitution, which, in some counties are quite large, ranging from 26 to 1,000. The cases of total and partial destitution in these 30 counties amount to over 40,000, while in other counties there are, probably, cases unreported sufficient to swell the aggregate to 50,000. In the more thinly populated counties of Nebraska and Dakota the number of such cases is, of course, smaller. Adding the cases east of Missouri, I do not think it out of the way to estimate the number of people affected by this pest at 75,000 to 100,000.”

ON SOME INJURIOUS INSECTS.

BY W. SAUNDERS, LONDON, ONTARIO.

THE CODLING MOTH (*Carpocapsa pomonella*, LINN).
THE PEAR TREE SLUG (*Selandria cerasi*, PECK).

THE CODLING MOTH (*Carpocapsa pomonella*, LINN).

This is, indeed, one of the most troublesome insects with which we have to contend, and one of the most difficult to deal with, and, although of foreign introduction, has spread over the greater part of our country entailing a yearly loss on our apple crop which it would be difficult to over estimate. We shall briefly give the various features in its life history with a cut illustrating the insect as it appears in its various stages, and then detail such measures as have been suggested with a view to its destruction.

Fig. 35.

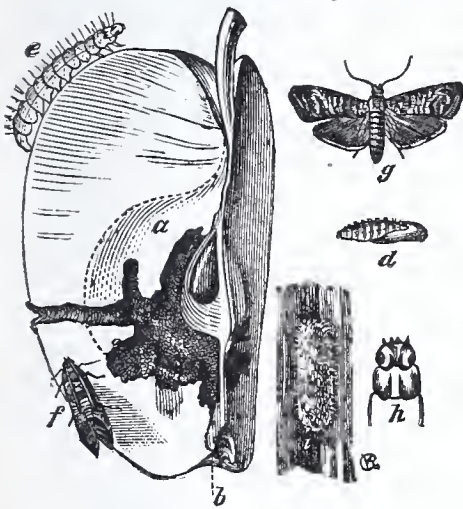


Fig. 35 represents a section of an apple which has been occupied by a codling worm—*b* shews the point of entrance of the young worm, the place of exit of the matured larva being shown at the left hand side of the figure; *e*, the full-grown worm; *h*, its head and first segment magnified; *i*, the cocoon; *d*, the pupa removed from the cocoon; *f*, the moth with wings closed; *g*, the same with wings expanded.

Soon after it leaves the fruit in the fall, the larva selects some secluded nook or cranny, under loose bark of tree or other convenient hiding place, and there spins its tough papery-looking cocoon, and within this secure retreat it remains in the larval condition until early in spring, when, a few weeks before the final change takes place, it enters the chrysalis state. It seems strange that this tiny creature should be endowed with such a power of varying the length of its larval existence, that at this season the larva

should remain so long unchanged, while, in the case of the earlier summer brood, the change to chrysalis takes place almost immediately after the spinning of the cocoon. About the time of the opening of the apple blossoms this insect bursts its prison house and appears as a winged moth. See Fig. 35, *g*.

The moth deposits her eggs singly, and usually in the calyx or eye, just as the young apple is forming. In about a week the larva is hatched, and at once the tiny worm begins to eat its way through the apple to the core. Its castings are commonly pushed out through the hole by which it has entered, which is from time to time enlarged for the purpose; these usually adhere to the apple, so that, before the worm is full grown, infested fruit may generally be detected by the mass of reddish-brown exuviae protruding from the eye. Sometimes, as the larva approaches maturity, it eats a passage through the apple at the side, and out of this opening its castings are thrust, and here the mature worm escapes when full grown. The occupied apple generally falls prematurely to the ground, sometimes with the worm in it, but

more commonly after the worm has escaped. The larvæ which leave the apples while still on the trees, either crawl down the branches to the trunk of the tree, or otherwise let themselves down by a fine silken thread, which they spin at will, to the ground; in either case, the greater portion of them take refuge under the rough loose bark on the trunk of the tree, and there spin their cocoons. The second brood of moths appear from about the twentieth to the last of July. We have taken them on the wing at night as early as the nineteenth, but specimens confined in breeding boxes, have not, as a rule, made their appearance until about the end of the month. In the winged state they seldom live more than a few days, and in this brief space they pair, and the female deposits her eggs for the second brood of larvæ, and, for this purpose, wisely shows a preference for the later apples. The codling moth also attacks the pear, in some localities, most disastrously for the crop; the fruit, however, seldom falls to the ground until some time after the worm has left.

Dr. Wm. Le Baron, State Entomologist, of Illinois, has devoted much time and attention to the study of the history and habits of this insect, and has published in his last annual report an excellent paper on this subject. Mr. Riley, of St. Louis, has also made observations and experiments on this same insect, which corroborate those of Dr. Le Baron, these are referred to in the fifth and sixth annual reports on the noxious, beneficial and other insects of the State of Missouri; from both these sources we shall glean and make free use of such facts as we think will interest our readers.

The number of eggs each moth is capable of laying will, probably, average not less than fifty, but these are not all matured at once, but may be found, by careful dissection of the body of the moth, in various stages of development. Hence they must be deposited successively, the period probably extending over a week or more.

REMEDIES.

This is an all important matter in which, in this instance, man must rely chiefly on his own efforts, for although, doubtless, a large number of the worms and chrysalids are annually destroyed by birds, and another limited portion by parasitic insects, still from the advantageous shelter afforded them by the apple, and the fact of their movements after leaving it being mostly in the night time, the codling worm enjoys much immunity from natural foes.

Dr. Le Baron divides this practical portion of the subject, as far as man's work is concerned, into four heads, and here we cannot do better than quote from his excellent paper:—

“1st. Destroying the insects in their winter quarters.

“2nd. Picking the wormy apples from the trees.

“3rd. Gathering the wormy apples from the ground, or letting swine and sheep have the range of the orchard.

“4th. Entrapping the worms in bands and other contrivances.”

1st. *Destroying the insects in their winter quarters.*—When we consider that each female moth is capable of laying fifty eggs or more, and that every worm of the first brood ruins an apple, we can see the importance of destroying these insects before they leave their winter quarters. We have already mentioned that in the state of nature, these worms pass the winter in cocoons, concealed under the bark, or in the crevices of apple trees. The summer brood of worms, which remain but two weeks in the pupa state, sometimes content themselves with a very slight protection, but it is the nature of the insect to seek deep concealment, and the instinct of the second brood, which is to survive the winter, leads them to search for the deepest protection they can find. We, therefore, rarely find them under shallow and loose scales of bark, but very often in deep cracks and crevices, partially embedding themselves in the substance of the wood or bark. Any superficial scraping of the trees, or whitewashing, or other outward applications would not, therefore, be likely to reach many of them; and inasmuch as they may be hidden upon any part of the trunk or large branches, any attempt to discover them with the intention of digging them out would, evidently, be impracticable; but at the point where we become powerless the woodpeckers come to our aid. In their search for just such hidden worms as these, those busy foragers unite business with pleasure, and all through the wintry day the sharp rattle of their beaks may often be heard in the orchard, as with ear intent and sharpened beak, and appetite not less sharp, they pursue their hidden prey with unerring and fatal precision.

"A more efficacious way of destroying these worms as far as our own instrumentality is concerned, is to search for them about the barrels and bins in which fall and winter apples have been kept. I have heard of instances where the sideboards of the bins have been taken away from time to time, as the apples were removed and thrown one upon another, in which these boards became so fastened together by the webs of the worms between them, that a number of boards could be raised by taking hold of the upper one only. There can be no doubt that the destruction of the codling-worm at this stage of its existence, would be very effective, and that it has been by far too much neglected."

Our esteemed President, Rev. C. J. S. Bethune in his remarks on this subject in our report for 1870, says "a very favourite locality for these worms is the space between the hoops and staves of the barrels. We have found hundreds in such positions especially in the winter of 1868-9. Where this occurs it is by all means worth while to scald the barrels thoroughly outside as well as inside, as soon as they are emptied or even to burn them. When boxes or bins are made use of for storing the fruit, the worms are sure to find some crevices to suit them, which should be searched for, and treated as in the case of the barrels."

2nd. *Picking the wormy apples from the trees.*—We have stated above that the young worms, soon after they have entered the apple, begin to throw out their castings through the hole which they made in entering. As this hole must be originally almost microscopically minute, it is evident that they must enlarge the opening for this purpose. We further stated that a portion of the castings adhere to the rough and shrivelled calyx, forming a rust coloured mass, which is easily seen from the ground below. Some horticulturists have availed themselves of this circumstance for the purpose of removing the wormy apples from the trees before the worms have escaped. The plan is to beat off the wormy apples, or else pick them off by means of a wire hook attached to the end of a pole. These two methods can be very usefully combined by first jarring or beating off those apples which readily fall, and then going over the trees a second time with the pole and hook. The apples thus removed should of course be fed to swine, or otherwise treated so as to destroy the worms within. Too much value cannot be attached to these simple expedients, which in the case of a few choice trees, or even a small orchard, might almost be made to supercede the necessity of any other treatment."

"3rd. *Gathering the wormy wind-fall apples from the ground, or letting swine or sheep have the range of the orchard.*—This plan has been generally recommended as of very great importance. Its efficacy will depend, of course, upon the proportion of worms which fall to the ground in the apples, as compared with those which leave the apples whilst hanging upon the tree. Those which crawl down the branches spin up before reaching the ground, and those which let themselves down by a thread, would, for the most part, be detected only by birds or by domestic fowls, and as there is reason to believe that they usually perform this act in the night, even these must fail to capture them."

"With regard to those wind-falls which contain worms, it is necessary to gather them frequently, that is every day or every second day at farthest. The apples do not usually fall until the worms are nearly matured, and they leave them in the course of a few days. If you examine indiscriminately a large number of wind-fall apples lying under the trees, you will be surprised to find how few worms they contain, they evidently having left the fruit before it fell, or soon after."

"But the most important question in this connection is, what proportion of the worms leave the apples before they fall from the tree? I have endeavoured to arrive at an approximate estimate upon the subject by putting two or more bands upon the same tree, upon the presumption that the worms descending from above will spin up in the upper band, and those crawling up from the ground in the lower. The following tables numbered for the purpose of reference give the results of these experiments. The wind-fall apples were left in every case as they fell upon the ground."

"On the tenth of July, 1871, I put bands as follows, upon four trees, the ground underneath being bare, or free from grass or rubbish of any kind. One band was put about a foot from the ground, another about two feet higher on the trunk, and others on two or three of the larger branches, eight or ten feet from the ground. They were examined July 28th, eighteen days after they were put on."

No. 1.

Whole number of worms in all stages.....

220

Number of empty pupa cases	28	
Number of pupæ.....	127	
Number of enclosed but unchanged larvæ.....	55	
	—	220
Number of all stages in lowest bands.....	94	
Number of all stages in upper trunk bands.....	83	
Number of all stages in bands on limbs.....	43	

No. 2.

(Same trees examined August 11th, (two weeks later.)

Number of pupa cases.....	16	
Number of pupæ.....	24	
Number of larvæ.....	15	
	—	65

Of these there were in lowest bands 21, middle or upper trunk 13, and on limbs 31.

No. 3.

(Same trees August 25th, two weeks from last.)

Number of pupa cases.....	1	
Number of pupæ.....	4	
Number of larvæ unchanged.....	41	
	—	46

Distributed as follows, in lowest bands 24, middle or upper trunk 15, in bands on limbs 7.

No. 4.

(Same trees September 9th, fifteen days later. Found larvæ only.)

Number in lowest bands.....	33	
Number in middle bands	39	
Number in bands on limbs... ..	9	
	—	81

No. 5.

(Same trees September 23rd, two weeks later. Larvæ only.)

Number in lowest bands.....	28	
Number in middle bands.....	22	
Number in bands on limbs.....	4	
	—	54

“ On the fourth of July, 1872. I selected a smooth thrifty apple-tree, six inches in diameter, growing upon grass land, and well filled with apples, bearing many marks of being wormy, but remarkably tenacious, and consequently but few lying upon the ground. Put two bands upon the trunk, one a foot and a half above the other.

“ Examined July 23rd, a moderate number of apples having in the meantime fallen upon the ground.

Whole number in the lower band	150	
Whole number in the upper band	110	
	—	260

"The bands in this experiment were made of carpet six inches wide, and long enough to go twice around the tree, making a very abundant covert for the worms. As might have been anticipated, in this case the greater part of the worms in the upper band were found in its upper half, indicating that the worms had reached it by descending from above; and on the other hand, the greater part of the worms in the lower band were in its lower half, showing that they had come up from the ground. We say the greater part, but not all, implying that some worms in each case had passed over one band and gone on to the next."

The above tables furnish data for many interesting and practical deductions.

"First, as respects the question now under consideration, namely, what proportion of the worms leave the apples before they fall from the tree; if we add together all the worms found in the highest and the lowest bands respectively, and divide those in the middle or upper trunk bands equally between the other two, we shall have 436 in the lower bands, and 290 in the upper, implying at first view that much the larger number came up from the ground. But there are several circumstances in these experiments which must be taken into account, and which will somewhat modify this conclusion. First, many of the limbs have no bands upon them, and the worms from these may be presumed to have found covert chiefly in the upper bands on the trunk. Second, two of the trees experimented upon were large rough trees, and a part of the worms undoubtedly spun up under the scales of bark on the limbs above the bands. And thirdly, we do not know what proportion of the worms may have let themselves down to the ground by threads, and thus found shelter under the lowest bands. Taking these circumstances into account, we shall perhaps arrive at an approximation sufficiently accurate for practical purposes, if we divide the whole number of worms equally between the upper and lower bands, from which we infer that about half the worms crawl down the tree, and the other half reach the ground either in the apples or by threads. We must infer from this as far as one series of experiments enables us to judge, that the gathering of wind-fall apples, either by ourselves or by the aid of domestic animals, enables us to destroy less than half of the codling worms.

"The animals used for this purpose are hogs and sheep, the latter are more cleanly, and equally effective, but they are liable to damage young trees by gnawing the bark."

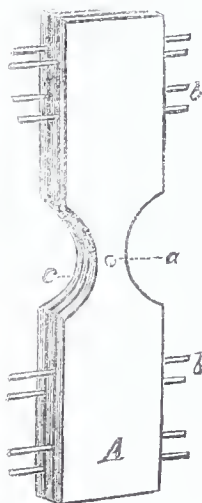
4th. *Entrapping the worms under bands, &c.*—Our own experience in a series of experiments, very similar to those above detailed, was much the same, excepting in the number of larvæ captured, which from five trees did not, at any one time, exceed 47, the distribution in the upper and lower bandages being nearly in the same proportion as that given by Dr. Le Baron. This method of entrapping the worms under bands is without doubt the most effective remedy yet devised, and if it were generally and persistently followed would effect a large yearly saving in the crop of this valuable fruit. It is of great importance that united effort should be made in this case, as the evil is an increasing one, and the yearly loss now entailed something enormous. With us we have known the full-grown larva to be found under bandages as early as the 4th of July, hence we think that their application should not be delayed later than the 1st. Indeed it would be wise to apply them a few days earlier than this. By referring to the first and second captures in Dr. Le Baron's first experiment, it will be observed that quite a number of empty pupa cases were found, 54 in all, showing that sufficient time had elapsed before examination to allow of the larvæ passing through the stage of chrysalis, and escaping as a perfect insect to continue its work of destruction. To prevent escapes of this sort we should recommend that the bandages be examined every ten days until the latter end of August. After this, worms of the second brood only will be found, and since these remain in the larval state until the following spring, the bands subsequently might be examined at leisure.

As to the material to be used for bandaging we have found old sacking, (which can often be obtained at trifling cost), to answer a very good purpose, cut into strips from six to eight inches wide, and long enough to go two or three times around the tree, and tied in the middle with a piece of stout twine. Strips of old carpet or cloth where they can be obtained, would, of course, prove equally good. In the excellent report of the Michigan Pomological Society, for 1873, we find that much interest is being excited throughout that State in reference to the codling moth, and many practical discussions are reported on the best means of fighting it, all however, agreeing in recommending the use of bandages. One apple grower recommends a bandage of common brown paper tied around the tree with a string; another while recommending the paper thinks the string too much trouble, and advises the use of a tack to fasten the end of the bandage with. One advantage claimed for this material for bandaging is that birds

readily find the hiding places of the larvæ, pierce through the thin covering and capture the worms, thus employing the efficient aid of our feathered friends in this useful work. One gentleman is reported to take no trouble to remove his paper bandages, merely securing them to the tree and allowing the birds to do the capturing, replacing the paper only when it is torn to shreds. Another prefers to use bands of cloth four inches wide, fastening the end with a tack, he usually finds all the worms by simply turning the edges of the cloth up and down without taking off the band. Still another thinks all strings and tacks a bother, and fastens the bandage quite securely by merely tucking the end under.

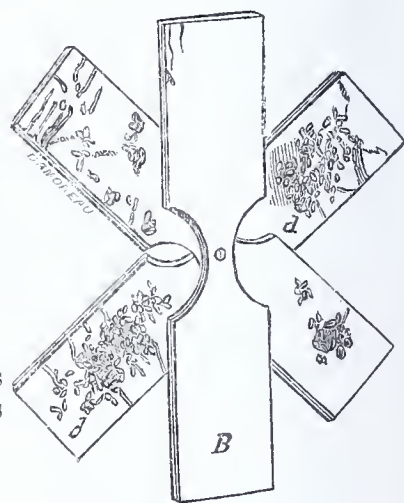
With reference to the economy of paper bandages, Mr. Riley in his fifth annual report, thus writes, "common straw paper 18 x 30 can be bought for 60 cents per bundle. Each bundle contains 240 sheets, and each sheet folded lengthwise thrice upon itself, will give us eight layers between two and three inches wide, and be of sufficient length to encircle most ordinary trees. It is easily drawn around the tree and fastened with a tack, and so cheap that when the time comes to destroy the worms, the bandages containing them may be detached, piled in a heap and burned, and new ones attached in their place. If eight bandages are used to each tree during the season the cost will be just two cents per tree."

Fig. 36.



Wier's shingle trap, (see Figs. 36 and 37, 36, the trap closed, 37, the same opened), has also been recommended, it is made usually of three pieces of old shingle about a foot long, and from four to six inches wide, fastened together and then nailed or serewed to the tree. In arranging the pieces the narrower ones should be placed next to the tree; it is also recommended to put a few bits of straw between the shingles so as to keep them slightly apart, experience, however, teaches that this trap is not so efficient or convenient as either of the bandages already referred to.

Fig. 37.



BRIEF SUMMARY.

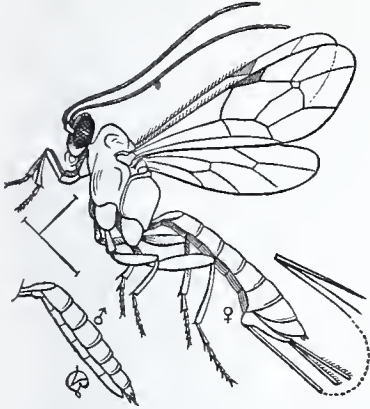
While all other available means tending to the lessening of the numbers of the codling moth worms should be unhesitatingly employed, the chief reliance should be placed on the bandages, use strips of cloth, old carpet or sacking where these can be had, but if these materials are not readily procurable use paper or cotton. Bandages should be from four to eight inches wide and either fastened with a string or with a tack at the end, and will be all the better if long enough to go twice around the tree; they should be fastened about half way up the trunk of the tree some time during the latter part of June, and be examined every ten days from the first of July until the last of August and at least once after the crop is secured. Care must be taken in unwinding the bandages to prevent the worms from escaping by dropping to the ground, which they readily do when their cocoons are thus torn asunder. A common clothes wringer, to pass the bandages through, is one of the readiest and surest methods of destroying the worms; and in this way the bandages can be rapidly handled and re-applied. Be careful to scrape the rough bark off old trees so that the worms may not find suitable hiding places either in descending or ascending the trunk until they reach the bandage; attend to these instructions regularly and thoroughly, and try and induce all your neighbours to follow your example and rest assured that good results will attend united effort.

PARASITES RECENTLY DISCOVERED.

To Mr. Riley, of St. Louis, belongs the honour of being the first to discover true parasites affecting the codling moth worm, descriptions of which are given in his Fifth Annual Report (873). "Both of them are Ichneumon flies and the first may be called

“THE RING-LEGGED PIMPLA (*Pimpla annulipes*, BR).

FIG. 38.



“This is a black fly, varying considerably in size, the female sometimes measuring but $\frac{1}{4}$, at others fully $\frac{1}{2}$ inch exclusive of ovipositor; the male somewhat smaller. The genus *Pimpla* was briefly characterized in my last report, p. 43, where it was shown that this same species attacks the walnut case bearer (*Acrobasis juglandis*, LEB). I annex a lateral outline of a female *Pimpla*, Fig. 38, the male has a more slender abdomen which is unarmed.

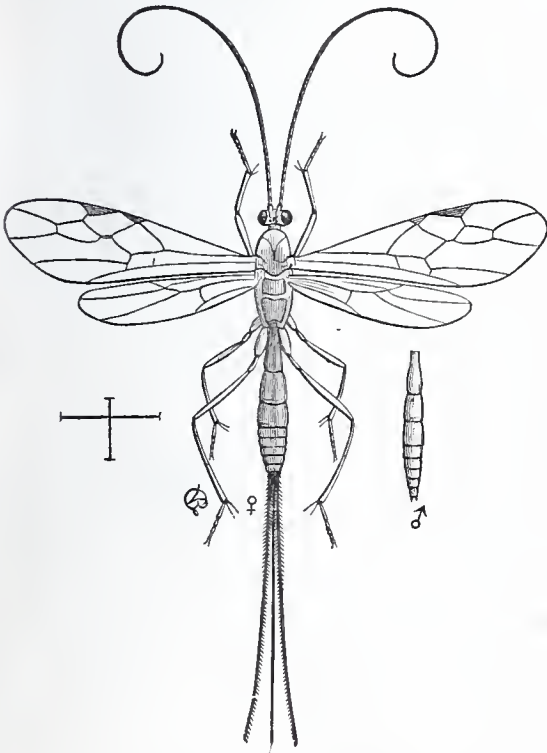
“*PIMPLA ANNULIPES* is black: the abdomen rough punctured above, with the borders of the joints polished and inclined to brown. The tegulae are white, and the legs are reddish, with the exception of the middle and hind tibiae, which are dusky—especially the hind pair—and have a broad white annulus, sometimes indistinct on the middle pair. The posterior tarsi are dusky, especially at tip. The palpi are pale yellow. Cresson says it may be distinguished from the other species of the genus, by the scutellum being black, the tegulae white, and the anterior coxae yellowish red.

“This fly eats its way through the chrysalis and the cocoon of the Codling Moth, without having previously made any cocoon of its own. It was quite abundant last summer as from one lot of *Carpocapsa* cocoons, I obtained 21 parasites—all of them females but one. It is a widely distributed and common species. The second parasite may be called the

“DELICATE LONG-STING. (*Macrocentrus delicatus*, CRES).

“It has recently been described by Mr. E. T. Cresson (*Trans. Am. Ent. Soc.* iv., p. 178), and is a somewhat variable species, occurring throughout the Eastern, Middle and Western, States, and in Mexico. I subjoin a description drawn up from my bred specimens.

FIG. 39.



“Male. Length 0.25; expanse 0.45; inch. Slender, colour pale, polished, honey yellow; uniformly and sparsely pubescent; tinged with brown superiorly, the basal joint of abdomen and a medio-dorsal line on the other joints being quite brown. Head, with the eyes (except at disc), and a spot between ocelli, brown-black; palpi long and almost white; antennae one-fourth longer than the whole body, about 48 joints, exclusive of bulbus, curled at tip, the ends of basal joints and the whole of joints dusky. Thorax, with the sutures well defined, and two small triangular black spots behind front tegulae, the metathorax strongly trilobed; legs very long, pale honey yellow, with tips of tibiae and tarsi faintly dusky; wings yellowish, hyaline and iridescent, with the veins luteous, and the stigma pale honey yellow.

“Female. Rather larger and with the abdomen somewhat paler, otherwise similarly marked. Ovipositor yellow, $\frac{1}{5}$ longer than body, the sheaths quite pilose, and inclining to fuscou. Described from 2 females and 1 male.

“It is a graceful fly with very long antennae and legs, and the female with a long ovipositor Fig. 39, “(the hair lines at the side of the figure show the natural size of the fly).”

The colour is pale honey yellow inclining to brown above. The unfortunate apple-worm is probably pierced while yet in the fruit, as it always succumbs soon after forming its cocoon,

and before changing to chrysalis ; while in the case of *Pimpla*, it is probably attacked either while leaving the fruit or after having spun its cocoon. The larva of the Delicate Long-sting forms, for itself, within the cocoon of its victim, a sufficiently tough, thin, oblong-oval, shiny, brown cocoon from which the perfect fly issues by cutting open a lid at one end.

"As both these parasites transform within the *Carpocapsa* cocoon, it is next to impossible and quite impracticable, to separate friend from foe in removing and destroying the contents of the bandages. But where it is desired to disseminate the parasites they may be bred by enclosing large numbers of *Carpocapsa* cocoons in some tight vessel."

On the 13th of August, 1873, we took a number of chrysalides of the Codling Moth under a bandage on an apple tree and among them there was one which was infested by Ichneumon. The chrysalis when emptied was found to contain six of the parasitic larvæ of which the following description was taken. Length a little over one-tenth of an inch, body tapering almost to a point towards the head. Colour, dull, yellowish white with a tinge of yellow along the dorsal region, very transparent the internal organs showing plainly through. On each segment is a transverse row of short whitish spines, terminal segment encircled with stouter whitish spines. No proper feet or prolegs, but in moving, the mouth-parts attach first with a sucker-like disk and the hinder portions of the body are drawn gradually forward, different portions of the under surface being furnished with small fleshy prominences which are attached and in turn withdrawn from the surface on which the larva is moving ; the principal points of attachment, however, seem to be the first and terminal segments, under the latter when viewed sideways, there appears a fleshy projection much larger than any of those on the other segments, and this projection expands into a flattened disk which holds the larva firmly to the place of attachment.

We did not succeed in rearing these larvæ ; after the chrysalis which contained them was broken open they, one after another died in spite of all our efforts towards their preservation. Whether this would have proved distinct from the species last described by Mr. Riley, and thus made a third true parasite on this pest we are unable at present to determine.

THE PEAR TREE SLUG.

Selandria Cerasi. Peck.

In the year 1790 Prof. Peck wrote a pamphlet entitled "Natural History of the Slug Worm," which was printed in Boston the same year by order of the Massachusetts Agricultural Society, and which obtained the Society's premium of fifty dollars and a gold medal. This, as far as we have been able to learn, was the first published record relating to the ravages of this insect in America. Forty-two years later (in 1841) Dr. Harris published his valuable treatise "On some of the insects injurious to vegetation in Massachusetts," in which when treating of this insect he gives the substance of Prof. Peck's remarks in a condensed form, portions of which material we shall avail ourselves of without further acknowledgement. Although seventy-five years have passed since Prof. Peck's memoir was written, but very little has been added during the interval to our common stock of knowledge in reference to this pest. In the meantime, however, it has spread over the whole country, damaging more or less seriously the foliage of our pear, cherry, quince and plum trees every year.

These insects pass the winter in the chrysalis state, the parent flies, the progenitors of the mischievous brood of slugs, appearing on the wing from about the third week in May until

Fig 40.



the middle of June. The fly (See Fig. 40) "is of a glossy black colour, excepting the first two pairs of legs, which are dirty yellow or clay coloured with blackish thighs, and the hind legs which are dull black with clay coloured knees. The wings are somewhat convex and rumped or uneven on the upper side like the wings of the saw flies generally. They are transparent, reflecting the colours of the rainbow, and have a smoky tinge forming a cloud or broad band across the middle of the first pair ; the veins are brownish. The body of the female measures more than one-fifth of an inch in length, that of the male is smaller." Early in June these flies may be found resting in the early morning, or in the cool of the evening, on the upper or under side of the leaves of pear, cherry or plum trees, some seasons they are very plentiful, while at other times but few are met with. When jarring our plum trees for cureulios at this season we usually find some on the sheets after jarring, they fall to the ground very

much like the curculio does, and remain for a short time motionless ; their structure, however, is not such as will permit of their disguising themselves as thoroughly as the "little turk" does, and hence they are easily detected. During the past season these flies were very numerous during the early part of June, and their progeny was destructive in a corresponding degree later in the summer.

After pairing the female places her eggs singly within little semicircular incisions through the skin of the leaf, which is frequently followed by some discolouration at the point of insertion. Harris says that the eggs are generally placed on the lower side of the leaves, whereas in our experience we have found them quite as often on the upper side. According to the same author the flies all finish this business of egg depositing and disappear within the space of three weeks. "The flies have not the timidity of many other insects, and are not easily disturbed while laying their eggs. On the fourteenth day afterwards the eggs begin to hatch, and the young slug worms (see those on leaf in Fig. 41) continue to come forth from the fifth of June to the 20th of July, according as the flies have appeared early or late in the spring."

Fig. 41.



At first the slugs are white; but a slimy matter soon oozes out of their skin, and covers their backs with an olive-coloured sticky coat. They have twenty very short legs, or a pair under each segment of the body excepting the fourth and the last. When fully grown (See *a* Fig. 41) they are about nine-twentieths of an inch in length. The head which is of a dark chestnut colour is small, and is entirely concealed under the fore part of the body. They are largest before, and taper behind, and in form somewhat resemble minute tadpoles. They have the faculty of swelling out the fore part of the body, and generally rest with the tail a little turned up. These disgusting slugs live mostly on the upper side of the leaves of the pear and cherry trees, and eat away the substance thereof, leaving only the veins and the skin beneath untouched. Sometimes twenty or thirty of them may be seen on a single leaf; and in the year 1797 they were so abundant in some parts of Massachusetts that small trees were covered with them, and the foliage entirely destroyed, and even the air by passing through the trees, became charged with a very disagreeable and sickening odour, given out by these slimy creatures. The trees attacked by them are forced to throw out new leaves, during the heat of the summer, at the ends of the twigs and branches, and this unseasonable foliage which should not have appeared until the next spring, exhausts the vigour of the trees, and cuts off the prospect of fruit."

"The slug worms come to their growth in twenty-six days, during which period they cast their skins five times. Frequently as soon as the skin is shed, they are seen feeding upon it; but they never touch the last coat which remains stretched out upon the leaf. After this is cast off, they no longer retain their slimy appearance and olive colour, but have a clean yellow skin, entirely free from vidity. They change also in form and become proportionally longer, and their head and the marks between the rings are plainly to be seen. In a few hours after this change they leave the trees, and, having crept or fallen to the ground, they burrow to the depth of from one inch to three or four inches, according to the nature of the soil. By moving their body the earth around them becomes pressed equally on all sides, and an oblong, oval cavity is thus formed, and is afterwards lined with a sticky glossy substance, to which the grains of earth closely adhere. Within these little earthen cells or cocoons the change to chrysalids takes place, and in sixteen days after the descent of the slug worms, finish their transformations, break open their cells, and crawl to the surface of the ground, where they appear in the fly form. These flies usually come forth between the middle of July and the 1st of August, and lay their eggs for a second brood of slug-worms. The latter come to their growth and go into the ground in September and October, and remain there till the following spring, when they are changed to flies and leave their winter quarters. It seems that all of them, however, do not finish their transformation at this time; some are found to remain unchanged in the ground till the following year; so that if all the slugs of the first hatch in any one year should happen to be destroyed, enough from a former brood would still remain in the earth to continue the species."

"The disgusting appearance and smell of these slug-worms do not protect them from the attacks of various enemies. Mice and other burrowing animals destroy many of them in their cocoons, and it is probable that birds also prey upon them when on the trees both in the

slug and winged state. Professor Peck has described a minute ichneumon fly, stated by Mr. Westwood to be a species of *Encyrtus*, that stings the eggs of the slug fly, and deposits in each one a single egg of her own. From this in due time a little maggot is hatched, which lives in the shell of the slug-fly's egg, devours the contents, and afterwards is changed to a chrysalis, and then to a fly like its parents. Professor Peck found that great numbers of the eggs of the slug-fly, especially of the second hatch, were rendered abortive by this atom of existence.

Sand, ashes, lime and hellebore have been recommended as remedies for this pest but the last mentioned is by far the most reliable. In 1870 we tried some experiments with these remedies, and reported in the *CANADIAN ENTOMOLOGIST* for September of that year, as follows :—

THE PEAR TREE SLUG.

This disgusting little larva, the progeny of a little blackish sawfly, has been very abundant during the past season and has been the subject of some notes and experiments. In the first place we noted that there were two broods in the season. The parents of the first brood, which pass the winter in the chrysalis state, appear on the wing about the second or third week in May, depositing eggs from which the slugs are hatched, becoming full grown from the middle to the end of June, then entering the chrysalis state underground; the second brood of the flies make their appearance late in July. This year we noticed them at work depositing eggs on the 21st, the young slugs were abundant and about a quarter of an inch long on the eighth of August, and by the sixth of September many of them were full-grown. With us they were much more destructive to cherry trees than to pear, consuming the upper surface of the leaves, soon giving the trees a scorched and sickly aspect, and in many cases the foliage fell off, leaving the trees almost bare.

As soon as the slugs were observed at work in Spring, they were treated to a plentiful supply of dry sand, thrown up into the higher branches with a shovel, and shaken over the lower ones through a sieve, which stuck thickly to their slimy skins, completely covering them up. Thinking we must have mastered them by so free a use of this long trusted remedy, we took no further heed of them for some days, when to our surprise, they were found as numerous as ever. The next step was to test this sand remedy accurately to see what virtue there was in it. Several small branches of pear trees were selected and marked, on which there were six slugs, and these were well powdered over—entirely covered with dry sand; on examining them the next morning it was found that they had shed the sand-covered skin and crawled out free and slimy again. The sand was applied a second and third time on the same insects with similar results; and now being convinced that this remedy was of little value, they were treated to a dose of hellebore and water, which soon finished them. Ashes were now tried on another lot, the same way as the sand had been, with very similar results. It was also intended to try fresh air slacked-lime, which we believe would be effectual, but having none on hand just then, the experiment was postponed, and the opportunity of testing it lost for the season. We must not omit mention of an experiment with hellebore. On the 13th of August, at eight a.m., a branch of a cherry tree was plucked, on which there were sixty-four slugs; the branch had only nine leaves, so that it may be readily imagined that they were thickly inhabited. A dose of hellebore and water was showered on them about the usual strength, an ounce to the pailful, when they soon manifested symptoms of uneasiness, twisting and jerking about in a curious manner; many died during the day, and only six poor, sickly-looking specimens remained alive the following morning, and these soon after died.

During the past season these slug worms have been unusually abundant on our pear trees, in many cases destroying the foliage so thoroughly that they looked as if they had been scorched by a fire, every leaf in some instances dropping from the trees, so that for a time they were bare as in mid-winter. Nearly a thousand trees in the young pear orchards of the writer suffered severely. During the latter part of June and the early days of July we had no opportunity of inspecting these trees, and when we visited them on the 7th of July they were so much injured that we thought they could not be much worse, and as the slugs were then full-grown and fast disappearing and the application of a remedy to so many trees a matter of much labour nothing was attempted to remedy the evil then.

It was observed that some trees were remarkably exempt from the attacks of these slugs Clapp's favourite deserves to be especially mentioned on this account, its thick glossy leaves

seemed to be uninviting, and when all around were seared, and browned, and withered trees of this variety wherever found were covered with a foliage rendered doubtly attractive and beautiful by the waste and dismal appearance of those about them. The following notes were taken at the time in reference to the relative damage inflicted on the different varieties of pear trees in those portions of the orchards most injured. *Beurre Giffard* most of the trees slightly, a few badly damaged. *Ananas d'Ete*, but slightly injured. *Beurre d'Amanlis*, same as *Beurre Giffard*. *Beurre Goubault*, entirely stripped. *Brandywine*, some stripped, others but little affected in the same row. *Doyenne d'Ete*, badly injured. *Bartlett* suffered very much, nearly all the trees being stripped. *Edmunds* injured badly, but not so much as *Bartlett*. *Souvenir de Congress*, nearly stripped. *Kirtland*, *Dwarfs*, not much affected. *Standards*, badly injured. *Leech's Kingessing*, scarcely touched. *Osbands Summer*, badly damaged, not a leaf left on many of the trees. *Rostiezer*, some very badly injured, others not so much. *Dearborns Seedling*, nearly stripped. *Tyson*, badly affected. *Ott's Seedling*, not much injured. *Marechale de la Cour*, nearly free. *Beurre de Montgeron*, *Frederica Bremer*, *Abbott and Fleur de Niede*, scarcely touched. *Beurre Diel*, some few trees very much injured, others not so badly. *Gansel's Bergamot*, stripped. *Buffum* and *Beurre Superfin*, scarcely injured. *Sheldon*, injured, but not badly. *Beurre de Waterloo*, scarcely touched. *Beurre Amande*, singularly free. *Beurre St. Nicholas*, *Oswego Beurre* and *Golden Beurre*, not much injured. *Beurre de Paimpool*, nearly stripped. It was intended to go over all the other varieties in a similar manner, but opportunity did not offer. In the course of another fortnight new leaves began to push out vigorously on the defoliated trees and within a month or six weeks all was green again.

In the meantime these mischief makers were preparing for a second descent, and we in turn were preparing to receive them; on the 29th of July, when going through the orchards in the afternoon, the new brood of flies were found in the greatest abundance, resting on the young leaves, or on those portions of green which still remained on the leaves partially eaten by the last brood, they were congregated, however, more especially on those trees where green leaves were most abundant. On disturbing them they would fall to the ground with the antennæ bent under their bodies, and the head bent forward. On half a dozen trees we caught about 60 specimens, and might have taken hundreds, they were so thickly spread that in many instances there were two and three on a single leaf. By the last week in August, the second brood of slugs were hatched; some very tiny creatures, others by this time half grown. Now, those trees which had previously escaped were all more or less covered, and would no doubt soon have been stripped, had not some measures been at once taken to destroy them. A raised platform was rigged up in a one horse cart in which was placed a barrel of water in which a pound of powdered hellebore had been mixed, and from the elevated stand this mixture was showered lightly on the trees from the rose of a watering pot. It was astonishing how quickly the trees were cleaned scarcely one could be found on a tree the morning after the application had been made, and ten pounds of hellebore with five or six days work of man and horse served to go over the whole ground, the work being completed in much less time than we had supposed it could.

THE GRAPE VINE PHYLLOXERA.

(*Phylloxera vastatrix*, PLANCHON.)

COMPILED BY THE REV. C. J. S. BETHUNE, M.A.

With the exception of the Colorado Potato Beetle, and the Locust of the Western States, of which we have given an account in another article, there is probably no insect that attracts more general attention at the present time than the destructive Grape-Vine Phylloxera (*P. vastatrix*, Planchon). To us in Canada it is but little known, but as its ravages may spread over our own vineyards at any time, and as it must be an object of interest to all vinegrowers, we think it proper to present to the readers of this Report an account of the insect and such other particulars as we are enabled to gather together. The fact of the rare occurrence of the insect in this country, and the consequent difficulties in the way of its study, is a sufficient reason, we trust, why we should offer a compilation from the writings of others, rather than attempt any original remarks of our own. Our quotations, unless otherwise specified, will be taken from the admirable paper on the Phylloxera, by our valued friend, Professor C. V. Riley, State Entomologist of Missouri, contained in his last Report (*Sixth Annual Report on the Insects of Missouri*, 1874, pages 30-87.) The estimation in which Mr. Riley's work in this respect is held in the great vine-growing countries of Europe, may be judged from the fact that, in the month of February last, he was presented with a very handsome gold medal by the Minister of Agriculture and Commerce of France, "in appreciation of his discoveries in Economic Entomology, and especially of his services rendered to French grape culture."

Though one form of the insect, the gall-inhabiting type, was noticed by Dr. Fitch, State Entomologist of New York, as long ago as 1856, very little attention was paid to it for some years. At length the serious disease of the grape-vine began to attract attention in France, and to cause so much alarm, that the authorities offered a prize of 20,000 francs for an effectual and practicable remedy. The disease was at first termed *pourridie*, or rotting—the roots becoming swollen and bloated, and finally wasting away. There were no end of surmises and theories as to cause, until Professor J. E. Planchon, of Montpellier, in July, 1868, announced that it was due to the puncture of a minute insect belonging to the plant-louse family (*Aphididae*), and bearing a close resemblance to our gall-louse." The following January, Professor Westwood, of Oxford, England, announced that he considered both the gall and root-inhabiting types to be different forms of the same insect. Shortly after a French writer gave it as his opinion that the European insect was identical with the American species long before described by Dr. Fitch. "This opinion," says Mr. Riley, "gave an additional interest to this insect, and I succeeded, in 1870, in establishing the identity of the French gall-insect with ours. During the same year I also established the identity of the gall and root-inhabiting types, by showing that in the fall of the year the last brood of gall-lice betake themselves to the roots and hibernate thereon. In 1871, I visited France and studied their insect in the field; and in the fall of that year, after making more extended observations here, I was able to give absolute proof of the identity of the two insects, and to make other discoveries, which not only interested our friends abroad, but were of vital importance to our own grape-growers, especially in the Mississippi Valley. I have given every reason to believe that the failure in the European vine, (*Vitis vinifera*), when planted here, the partial failure of many hybrids with the European *vinifera*, and the deterioration and death of many of the more tender-rooted native varieties, are mainly owing to the injurious work of this insidious little root-louse. It

had been at its destructive work for years, producing injury the true cause of which was never suspected until the publication of the article in my fourth Report. I also showed that some of our native varieties enjoyed relative immunity from the insects' attacks, and urged their use for stocks, as a means of re-establishing the blighted vineyards of Southern France."

"The disease continued to spread in Europe, and became so calamitous in the last-named country that the French Academy of Sciences appointed a standing Phylloxera Committee. It is also attracting some attention in Portugal, Austria and Germany, and even in England, where it affects hot-house grapes."

NATURAL HISTORY OF THE INSECT.

The genus *Phylloxera* is characterized by having three-jointed antennæ, the third or terminal being much the longest, and by carrying its wings overlapping, flat on the back instead of roof-fashion. It belongs to the sub-order of whole-winged bugs (*Homoptera*), and forms a connecting link between two of its great families, the Plant-lice (*Aphididæ*) on the one hand, and the Bark-lice (*Coccidæ*) on the other. It is generally considered, however, to pertain to the former family, though some naturalists, with the not uncommon love of introducing new names and minute classifications, have desired to found a new family for this special insect.

Not the least interesting feature in the economy of the *Phylloxera* is the different phases or forms under which it presents itself. Among these forms are two constant types which have led many to suppose that we have to do with two species. The one type, which for convenience Mr. Riley terms *gallæcola*, lives in galls on the leaves; the other which he calls *radicicola*, lives on swellings of the roots. They may be tabulated thus:—

Type 1. *Gallæcola* (see Figure 43, *f, g, h*),

Type 2. *Radicicola*.

A, Degraded or wingless form (see Figure 44, *e, f, g*)

B, Perfect or winged form (see Figure 45, *g, h*.)

"**TYPE GALLÆCOLA OR GALL-INHABITING.**—The gall or excrescence produced by this insect is simply a fleshy swelling of the under side of the leaf, more or less wrinkled and hairy, with a corresponding depression of the upper side, the margin of the cup being fuzzy, and drawn together so as to form a fimbriated mouth. It is usually cup-shaped, but sometimes greatly elongated or purse-shaped.

Soon after the first vine-leaves that put out in the spring have fully expanded, a few

Fig. 42.



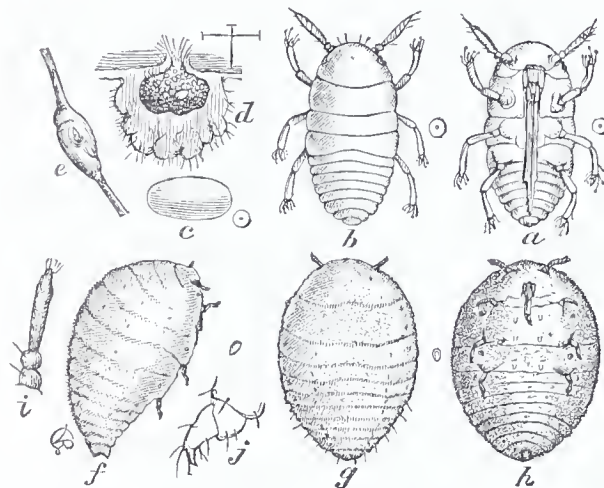
Under side of Leaf covered with Galls.

scattering galls may be found, mostly on the lower leaves, nearest the ground. These vernal galls are usually large, (of the size of an ordinary pea), and the normal green is often blushed with rose where exposed to the light of the sun. On carefully opening one of them (Fig. 43, *d*) we shall find the mother-louse diligently at work surrounding herself with pale-yellow eggs of an elongate oval form, scarcely .01 inch long, and not quite half as thick (Fig. 43, *c*). She is about .04 inch long, generally spherical in shape, of a dull orange colour, and looks not unlike an immature seed of the common purslane. At times, by the elongation of the abdomen, the shape assumes, more or less perfectly, the pyriform. Her members are all dusky, and so short compared to her swollen body, that she appears very clumsy, and undoubtedly would be outside of her gall, which she never has occasion

to quit, and which serves her alike as dwelling-house and coffin. More carefully examined, her skin is seen to be shagreened or minutely granulated and furnished with rows of minute hairs. The eggs begin to hatch when six or eight days old into active

little oval, hexapod beings, which differ from their mother in their bright yellow colour and more perfect legs and antennæ, the tarsi being furnished with long, pliant hairs, terminating in a more or less distinct globule. In hatching, the eggs split longitudinally from the anterior end, and the young louse whose pale yellow is in strong contrast with the more dusky colour of the egg-shell, escapes in the course of two minutes. Issuing from the mouth of the gall, these young lice scatter over the vine, most of them finding their way to the tender terminal leaves, where they settle in the downy bed which the tomentose nature of these leaves affords, and commence pumping up and appropriating the sap. The tongue-sheath is blunt and heavy, but the tongue proper—consisting of three brown, elastic and wiry filaments, which, united, make so fine a thread as scarcely to be visible with the strongest microscope—is sharp, and easily run under the parenchyma of the

FIG. 43.

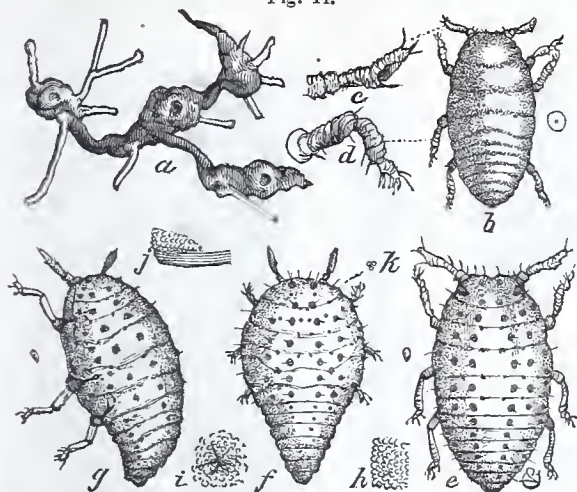


TYPE GALLÆCOLA:—*a, b*, newly-hatched larva, ventral and dorsal view; *c*, egg; *d*, section of gall; *e*, swelling of tendril; *f, g, h*, mother gall-louse—lateral, dorsal and ventral views; *i*, her antenna; *j*, her two jointed tarsi. Natural sizes indicated at sides.

leaf. Its puncture causes a curious change in the tissues of the leaf, the growth being so stimulated that the under side bulges and thickens, while the down on the upper side increases in a circle around the louse, and finally hides and covers it as it recedes more and more within the deepening cavity. Sometimes the lice are so crowded that two occupy the same gall. If, from the premature death of the louse, or other cause, the gall becomes abortive before being completed, then the circle of thickened down or fuzz enlarges with the expansion of the leaf, and remains (Fig. 43, *c*) to tell the tale of the futile effort. Otherwise, in a few days the gall is formed, and the inheld louse, which, while eating its way into house and home, was also growing apace, begins a parthenogenetic maternity by the deposition of the fertile eggs, as her immediate parent had done before. She increases in bulk with pregnancy, and one egg follows another in quick succession, until the gall is crowded. The mother dies and shrivels, and the young, as they hatch, issue and found new galls. This process continues during the summer until the fifth or sixth generation. Every egg brings forth a fertile female, which soon becomes wonderfully prolific. The number of eggs found in a single gall averages about 200; yet it will sometimes reach as many as 500, and, if Dr. Shimer's observations can be relied on, it may even reach 5,000. I have never found any such number myself; but, even supposing there are but five generations during the year, and taking the lowest of the above figures, the immense prolificacy of the species becomes manifest. As summer advances they frequently completely cover the leaves with their galls, and settle on the tendrils, leaf-stalks and tender branches, where they also form knots and rounded excrecences (Fig. 43, *e*) much resembling those on the roots. In such a case, the vine loses its leaves prematurely, usually, however, the natural enemies of the louse seriously reduce its numbers by the time the vine ceases its growth in the fall, and the few remaining lice, finding no more succulent and suitable leaves, seek the roots. Thus by the end of September, the galls are mostly deserted, and those which are left are almost always infested with mildew, and eventually turn brown and decay. On the roots the young lice attach themselves singly or in little groups and thus hibernate. The male louse has never been seen, nor does the female ever acquire wings. Indeed, too much stress cannot be laid on the fact that *Gallæcola* occurs only as an agamic and apterous female form. It is but a transient summer state, not at all essential to the perpetuation of the species, and does, compared with the other type, but trifling damage. It has been found occasionally by Mr. Riley on all species of the grape-vine (*vinifera*, *riparia*, *æstivalis* and *Labrusca*) cultivated in the Eastern and Middle States, and on the wild *cordifolia*; but it flourishes only on the river-bank grape (*riparia*), and more especially on the Clinton and Taylor, with their close allies. Thus while legions of the root-inhabiting type (*radicicola*) are overrunning and devastating the vineyards of France, this one is almost unknown there except on such American varieties as it infests with us."

"TYPE RADICICOLA OR ROOT-INHABITING.—We have seen that, in all probability, *gallæcola* exists only in the apterous, shagreened, non-tubercled, fecund female from. *Radici-*

Fig. 44.



TYPE RADICICOLA.—*a*, roots of Clinton vine, showing relation of swellings to leaf-galls, and power of resisting decomposition; *b*, larva as it appears when hibernating; *c*, *d*, antenna and leg of same; *e*, *f*, *g*, forms of more mature lice; *h*, granulations of skin; *i*, tubercle; *j*, transverse folds at borders of joints; *k*, simple eyes.

in the spring as many as two hundred and sixty-five eggs in a cluster, and all evidently from one mother, who was yet very plump and still occupied in laying. As a rule, however, they are less numerous. With pregnancy this form becomes quite tumid and more or less pyriform, and is content to remain with scarcely any motion in the more secluded parts of the roots, such as the creases, sutures and depressions, which the knots afford. The skin is distinctly shagreened (Fig. 44, *h*,) as in *gallæcola*. The warts, though usually quite visible with a good lens, are at other times more or less obsolete, especially on the abdomen. The eyes, which were quite perfect in the larva, become more simple with each moult, until they consist, as in *gallæcola*, of but triple eyelets (Fig. 44, *k*,) and, in the general structure, this form becomes more degraded with maturity, wherein it shows the affinity of the species to the *Coccidæ*, the females of which, as they mature, generally lose all trace of the members they possessed when born."

"The second or more oval form (Fig. 44, *e*,) is destined to become winged. Its tubercles when once acquired, are always conspicuous; it is more active than the other, and its eyes increase rather than diminish in complexity with age. From the time it is one-third grown the little dusky wing-pads may be discovered, though less conspicuously than in the pupa state, which is soon after assumed. The pupæ (Fig. 45, *e*, *f*,) are still more active, and after feeding a short time, they make their way to the light of day, crawl over the ground and over the vines, and finally shed their last skin and assume the winged state. In their last moult the tubercled skin splits on the back, and is soon worked off, the body in the winged insect having neither tubercles nor granulations."

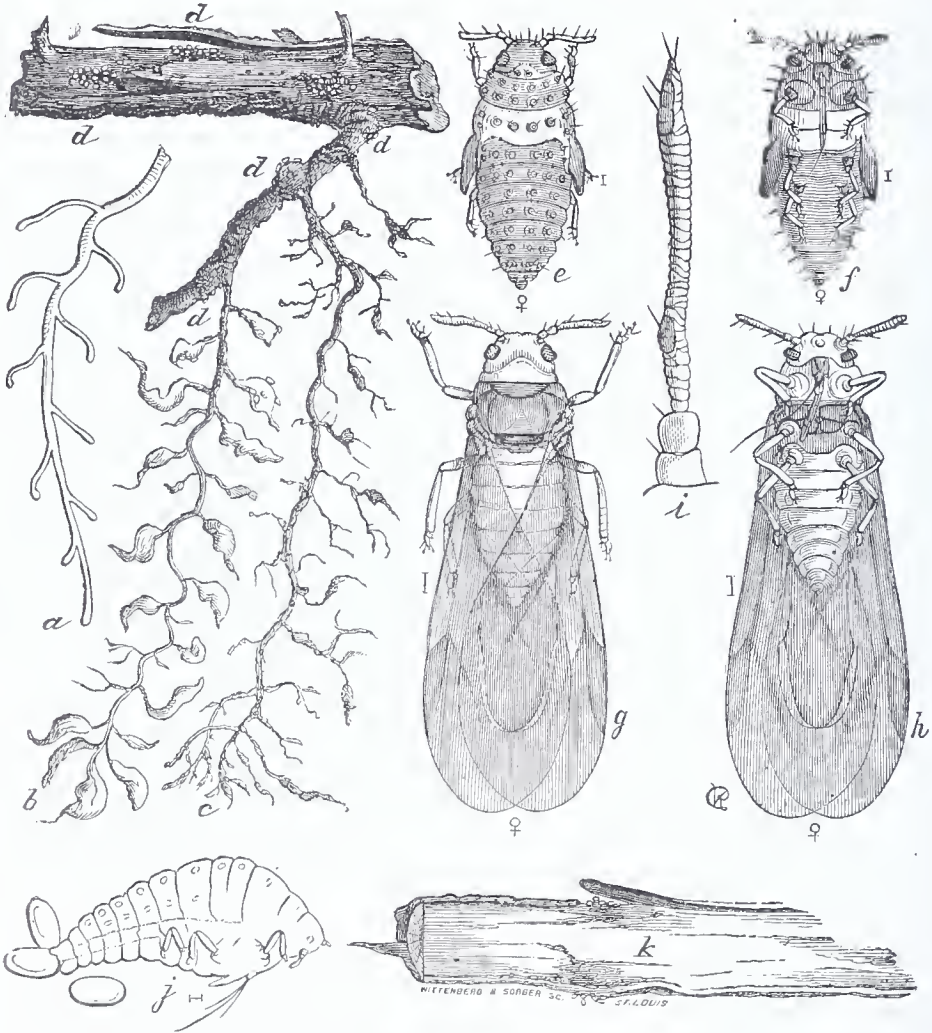
"The winged insects are most abundant in August and September, but may be found as early as the first of July, and until the vines cease growing in the fall. The majority of them are females, with the abdomen large and more or less elongate. From two to five eggs may invariably be found in the abdomen of these, and are easily seen when the insect is held up to the light, or mounted in balsam or glycerine."

"As fall advances the winged individuals become more and more scarce, and as winter sets in only eggs, newly-hatched larvæ, and a few apterous egg-bearing mothers, are seen. These last die and disappear during the winter, which is mostly passed in the larva state, with here and there a few eggs. The larvæ thus Libernating (Fig. 44, *b*) become dingy, with the body and limbs more shagreened and the claws less perfect than when first hatched; and, of thousands examined, all bear the same appearance, and all are furnished with strong

* "It is not to be understood, in making these distinctions, that these differences of form are so constant that they can always be relied on; for the form of the body varies, so that the wingless mother may present the more perfect oval of that destined to become winged."

suckers. As soon as the ground thaws and the sap starts in the spring, these young lice work off their winter coat, and, growing apace, commence to deposit eggs. All, without exception, become mothers, and assume the degraded form (A) already described.

FIG. 45.



TYPE RADICICOLA :—*a*, shows a healthy root ; *b*, one on which the lice are working, representing the knots and swellings caused by their punctures ; *c*, a root that has been deserted by them, and where the rootlets have commenced to decay ; *d*, *d*, *d*, show how the lice are found on the larger roots ; *e*, female pupa, dorsal view ; *f*, same, ventral view ; *g*, winged female, dorsal view ; *h*, same, ventral view ; *i*, magnified antenna of winged insect ; *j*, side view of the wingless female, laying eggs on roots ; *k*, shows how the punctures of the lice cause the larger roots to rot.

“At this season of the year, with the exuberant juices of the plant, the swellings on the roots are large and succulent, and the lice plump to repletion. One generation of the mother form (A) follows another—fertility increasing with the increasing heat and luxuriance of summer—until at last the third or fourth has been reached before the winged form (B) makes its appearance in the latter part of June or early in July. Such are the main features which the development of the insect presents, to one who has studied it in the field as well as in the closet.

“Since I proved, in 1870 (adds Mr. Riley), the absolute identity of these two types by showing that the gall-lice become root-lice, the fact has been repeatedly substantiated by different observers. Yet, strange to say, no one has heretofore succeeded in making gall-lice of the young hatched on the roots, though I formerly supposed that Signoret had done so. It is, therefore, with much satisfaction that I record the fact of having succeeded this winter in obtaining galls on a young Clinton vine from young *radicicola*, and of thus establishing beyond

peradventure, the specific interrelation and identity of the two types. I make this announcement with all the more pleasure, that for three years past, both on vines growing out-doors and in pots in-doors, I had in vain attempted to obtain the same result."

PRACTICAL CONSIDERATIONS.

"THE MORE MANIFEST AND EXTERNAL EFFECTS OF THE PHYLLOXERA DISEASE.

—The result which follows the puncture of the root-louse is an abnormal swelling, different in form, according to the particular part and texture of the root. These swellings, which are generally commenced at the tips of the rootlets, where there is excess of plasmatic and albuminous matter, eventually rot, and the lice forsake them and betake themselves to fresh ones—the living tissue being necessary to the existence of this as of all plant-lice. The decay affects the parts adjacent to the swellings, and on the more fibrous roots cuts off the supply of sap to all parts beyond. As these last decompose, the lice congregate on the larger ones, until at last the root system literally wastes away."

"During the first year of attack there are scarcely any outward manifestations of disease, though the fibrous roots, if examined, will be found covered with nodosities, particularly in the latter part of the growing season. The disease is then in its incipient stage. The second year all these fibrous roots vanish, and the lice not only prevent the formation of new ones, but, as just stated, settle on the larger roots, which they injure by causing hypertrophy of the parts punctured, which also eventually become disorganized and rot. At this stage the outward symptoms of the disease first become manifest, in a sickly, yellowish appearance of the leaf and a reduced growth of cane. As the roots continue to decay, these symptoms become more acute, until by about the third year the vine dies. Such is the course of the malady on vines of the species *vinifera*, when circumstances are favourable to the increase of the pest. When the vine is about dying, it is generally impossible to discover the cause of the death, the lice which had been so numerous the first and second years of invasion, having left for fresh pasturage."

MODE OF SPREADING.—The gall-lice can only spread by travelling, when newly-hatched from one vine to another; and, if this slow mode of progression were the only one which the species is capable of, the disease would be comparatively harmless. The root-lice, however not only travel under-ground along the interlocking roots of adjacent vines, but crawl actively over the surface of the ground, or wing their way from vine to vine and from vineyard to vineyard. Doubts have been repeatedly expressed by European writers as to the power of such a delicate and frail-winged fly to traverse the air to any great distance. On the 27th of September, 1873, the weather being quite warm and summer-like, with much moisture in the atmosphere, Mr. Riley witnessed the insect's power of flight. Some two hundred winged individuals, that he had confined, became very restless and active, vigorously vibrating their wings and beating about their glass cages. Upon opening the cages, the lice began to dart away and were out of sight in a twinkling. They have been caught in spider-webs in Europe, and captured by Mr. Riley on sheets of paper prepared with bird-lime and suspended in an infested vineyard; it is clear, then, that they can sustain flight for a considerable time under favourable conditions, and with the assistance of the wind, they may be wafted to great distances. These winged females are much more numerous in the fall of the year than has been supposed by Entomologists. Wherever they settle, the few eggs which each carries are sufficient to perpetuate the species, which, in the fullest sense, may be called contagious.

"SUSCEPTIBILITY OF DIFFERENT VINES TO THE DISEASE.—As a means of coping with the Phylloxera disease, a knowledge of the relative susceptibility of different varieties to the attacks and injuries of the insect is of paramount importance. As is so frequently the case with injurious insects, and as we have a notable instance in the common Currant Aphis (*Aphis Ribesii*), which badly affects the leaves of some of the Currants, but never touches the Gooseberry which belongs to the same genus. The Phylloxera shows a preference for and thrives best on certain species, and even discriminates between varieties; or, what amounts to the same thing, practically, some varieties resist its attacks and enjoy a relative immunity from its injuries. It would be useless, and certainly unnecessary here, to attempt to ascertain the reason why certain vines thus enjoy exemption while others so readily succumb; but in a broad way it may be stated that there is a relation between the susceptibility of the vine and the character of its roots—the slow-growing, more tender-wooded and consequently more tender-rooted varieties succumbing most readily; the more vigorous powers resisting best."

From Mr. Riley's synopsis of experiments and observations we gather the following statement respecting the different varieties of grape:—

EUROPEAN VINE (*Vitis vinifera*)—Rarely subject to leaf-gall, but it generally succumbs to the attacks of root-lice after a few years.

RIVER-BANK VINE (*V. riparia*)—The Cornucopia, Alvey and Othello suffer very little or not at all from Leaf-galls, but to a considerable extent from Root-lice. The Clinton and Taylor are very subject to the Leaf-galls, but from the great vitality of their roots they do not succumb to the attacks of the Root-lice. The Golden Clinton and Louisiana do not suffer much from either. The Marion a good deal affected by the former, but little by the latter. The Delaware suffers considerably from both.

SUMMER GRAPE (*V. æstivalis*)—The Cunningham, Norton's Virginia, and Rutlander suffer not at all from the Leaf-gall, and very little from the Root-lice. The Herbemont and Cynthiana suffer slightly from both.

NORTHERN FOX GRAPE (*Labrusca*)—The Challenge, Dracut Amber, Israella, Martha, Northern Muscadine and Wilder, are not subject to the Leaf-gall, and only slightly to the root-lice. The Diana, Goethe, Hartford, Isabella, Ives, Maxatawney, North Carolina, Rebecca and Salem are also free from the Leaf-gall, but have the Root-lice more abundant and suffer more from its attacks. The Catawba and Iona do not suffer from the Leaf-gall, but are most subject to the Root-lice. The Concord has the Leaf-galls but rarely, and does not suffer much from the Root-lice; the Creveling also is usually free from the former, but suffers much more from the latter.

SOUTHERN FOX GRAPE.—This species is entirely free from the Phylloxera in any form.

The above enumeration is founded principally upon Mr. Riley's observations in the central portion of Missouri; he has also examined many of the varieties in Kansas, Illinois, New Jersey, Pennsylvania and New York. The Arnold's hybrids, which he has examined, all suffer, he states, but some of them more than others.

MEANS OF COPING WITH THE DISEASE.—Crafting the more susceptible varieties on the roots of those that have a greater power of resistance, would probably counteract the disease to a great extent. This plan is now being tried on a large scale, but it will be necessary to wait a year or two before any positive conclusions can be obtained.

"In planting a new vineyard the greatest care should be taken not to introduce Phylloxera on the young plants, and a bath of weak lye or strong soap suds before planting will, perhaps, prove the best safeguard. Remembering that the lice are spreading over the ground from July till fall, and principally in the months of August and September, a thorough sprinkling of the surface with lime, ashes, sulphur, salt or other substance destructive to insect life, will, no doubt, have a beneficial effect in reducing their numbers and preventing their spread.

The insect has been found to thrive less and to be, therefore, less injurious in a sandy soil; while mixture of soot with the soil has had a beneficial effect in destroying the pest. It is, therefore, recommended for the more susceptible varieties, and that they be planted in trenches first prepared with a mixture of sand and soot. An addition of lime will also prove beneficial. There is every reason to believe that vines are rendered less susceptible to the disease by a system of pruning and training that will produce long canes and give them as nearly as possible their natural growth.

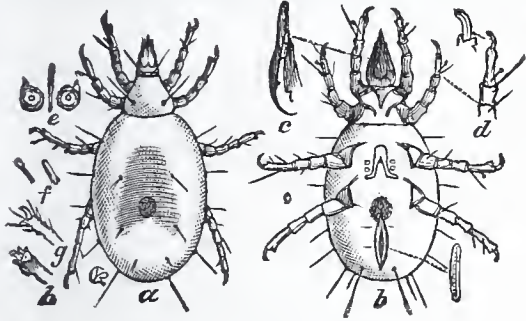
NATURAL ENEMIES.—There are a number of predaceous insects which serve to keep the leaf-lice in check; but as the injury is mostly done underground it will suffice to enumerate the principal of these in this connection. The most efficient is a black species of Fringe-wing or Thrips with white wings (*Thrips Phylloxeræ*). They are found in several different kinds of Phylloxera galls, and do more than any other species to keep the leaf inhabiting species within bounds."

The next most efficient aids in the destruction of the leaf-lice are the lace-winged flies (*Chrysopa*); the lady birds (*Coccinella*); certain Syrphus fly larvæ; a few true bugs and other insects.

The enemies known to attack the Phylloxera underground are, naturally enough, fewer in number. In one instance, Mr. Riley relates, I have found a *Scymnus* larva at the work six inches below the surface, and there is a *Syrphus* fly, whose larva lives under-ground and feeds both on the apple-tree root-louse and on this grape root-louse. Wonderful indeed

is the instinct which teaches this blind larva to penetrate the soil in search of its prey ; for the egg must necessarily be laid at the surface. But though the underground enemies of its own class are few, I have discovered a mite which preys extensively upon this root-inhabiting type, and which renders efficient aid in keeping it in check in this country. This mite (*Tyroglyphus phylloxerae*, Planchon & Riley, Fig. 46,) belongs to the same genus as the cheese and meal mites, and the species which infests preserved insects, and is such a pest in cabinets. At is the rule with mites, it is born with but six legs, but acquires eight after the first or second

FIG. 46.



PHYLLOXERA MITE, a, dorsal, b, ventral view of female, c, mouth-parts, d, f, g, h, forms of tarsal appendages, e, ventral tubercles of male.

preys by preference on the lice themselves."

"DIRECT REMEDIES.- The leaf-lice, which do not play such an important part in the disease as was at first supposed, may be controlled with sufficient ease by a little care in destroying the first galls which appear, and in pruning and destroying the terminal growth of infested vines later in the season. The root-lice are not so easily reached. As the effort will be according to the exigency, we may very naturally look to France for a direct remedy, if ever one be discovered. But of all the innumerable plans, patented or non-patented, that have been proposed, of all the many substances that have been experimented with under the stimulus of a large national reward, no remedy has yet been discovered which gives entire satisfaction, or is applicable to all conditions of soil. Nor is it likely that such a remedy ever will be discovered.

"While, therefore, not very satisfactory results have followed the use of pure insecticides, the application of fertilizers intended to invigorate the vine, and at the same time injure the lice, has been more productive of good. Especially has this been the case with fertilizers rich in potassic salts and nitrogenous compounds, such as urine. Sulphuret of potassium dissolved in liquid-manure; alkaline-sulphates, with copperas and rape seed; potassic salts, with guano; soot and cinders are, among other applications, most favourably mentioned.

Mr. Riley closes his very able Essay with the following remarks:—"We have in the history of the Grape Phylloxera, the singular spectacle of an indigenous American insect being studied, and its workings understood in a foreign land, before its presence in its most injurious form was even suspected in its native home. The Franco-Prussian war, with all its fearful consequences to France, has passed away; the five milliards of francs (one thousand million dollars) have been paid as indemnity to her victors, in so short a time that the civilized world looked on in wonder and astonishment. Yet this little Phylloxera, sent over doubtless in small numbers, by some American nurseryman, a few years since, continues its devastating work, and costs that unfortunate country millions of francs annually. The last German soldier has been removed—at terrible cost it is true—from French soil, but the Phylloxera army remains; and if another five milliard francs could extirpate the last individual of this liliputian insect host from her soil, "la belle France" would be cheaply rid of the enemy. Had the world, twenty years ago, possessed the knowledge we at present have of this insect and of its dangerous power, a few francs might have originally stayed its invasion of that great vine-growing and wine-making country. Needs there any more forcible illustration of the importance of economic entomology!"

In confirmation of this statement, we read in the monthly report of the Department of Agriculture (Washington, August and September, 1874), that "the Prefect of the Department of the Rhone, in France, has published a decree directing the mayor of each Commune within his jurisdiction, upon the indication of the presence of the Phylloxera, to proceed at

once to determine the limits of each local district infected by the insect. Every vine affected and all the roots within five meters are to be dug up and burned. This decisive measure has not escaped sharp criticism. To save the vine lands of the Rhone from destruction by this pest, it is now proposed to secure winter irrigation by a grand canal connected with that river. M. Dumont, *Ingénieur en chef des chaussées*, has developed, before a governmental commission, a scheme for the construction of such a canal, within four years, at a cost of 102,000,000 francs. This, it is supposed, will rescue from destruction over 60,000 acres of vine lands, yielding products worth 200,000,000 francs per annum and taxes amounting to 20,000,000 francs."
